1997

Revised

EV1™

Brakes

Service Manual

CamScanner

CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specifically designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure, or tool that is not recommended by the vehicle manufacturer must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure, or tool selected.

It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during service or repair or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive; it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

This vehicle has a high voltage power system. Disabling the system is required when working on or around the high voltage system and high voltage battery pack (other than testing the system using the procedures in this manual).

To help avoid severe shocks and burns and vehicle damage, always follow the cautions in this manual to disable the high voltage system. See the high voltage disable and enable procedure in the front of this service manual.

This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to "CAUTIONS" under "On-Vehicle Service" and the SIR Component and Wiring Location views in the "SIR Service Manual" before performing service on or around SIR components or wiring. Failure to follow "CAUTIONS" could result in possible air bag deployment, personal injury, otherwise unneeded SIR system repairs.

To help avoid accidental air bag deployment and personal injury, when servicing a vehicle that requires repair of the SIR system and another vehicle system, it is recommended that the SIR be repaired first using service manual procedures.

CAUTION

Saturn Service Manuals are intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others and damage to your vehicle that may cause it not to operate.

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BRAKES

NOTICE

Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application.

The applicable service procedure will identify, where necessary, those fasteners that must be replaced after removal; or those fasteners that require thread lockers or thread sealant.

UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener.

When you install fasteners, use the correct tightening sequence and specifications.

Following these instructions can help you avoid damage to parts and systems.

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NOTES

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GLOSSARY OF ACRONYMS

Acronym	Definition
ABS	Anti-Lock Braking System
AM	Amplitude Modulation
Amp	Ampere
APM	Accessory AC and DC Power Control Module. With PIM, makes up PEB
APS	Auxiliary Power Supply (part of APM)
BCA	Bias Control. Assembly
BPM	Battery Pack Module
BRS	Battery Reserve Switch
BTCM	Brake/Torque Control Module
BTSI	Brake Transmission Shift Interlock (GM)
CD	Compact Disc
cfm	Cubic Feet per Minute
cg	Center of Gravity
CHMSL	Center High-Mount Stop Lamp
CMC	Compressor Motor Controller (part of APM)
CPA	Connector – Positive Assurance
CR	Charge Receptacle
CRFM	Condenser Radiator Fan Module (part of HPVS)
CTPS	Check Tire Pressure System
DC	Direct Current
DLC	Data Link Connector
DERM	Diagnostic and Energy Reserve Module (SIR control module)
DIA	Dealer Installed Accessory
DM	Drive Motor
DRL	Daytime Running Light
E/M	English/Metric
ECM	Engine Control Module (used with internal combustion engines)
EHPS	Electro-Hydraulic Power Steering
EKP	External Keypad
EMB	Electro-Magnetic Brake (part of ABS)
EMI	Electromagnetic Interference
EPS	Electric Power Steering. Also see EHPS

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GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
EEPROM	Electronically Erasable Programmable Read Only Memory
ETS	Electronic Traction System
EV	Electric Vehicle
EVO	Electronic Variable Orifice Control
FLIP	Forward Lamp – Instrument Panel Harness. Name of major EV low voltage wire harness
FM	Frequency Modulation
FOD	Front of Dash
g	Gram
GFI	Ground Fault Interrupt
GVMR	Gross Vehicle Mass Rating
GVW	Gross Vehicle Weight
HPVM	Heat Pump Ventilation Module
HPVS	Heat Pump Ventilation System. Similar to HVAC on ICE vehicles
HTCM	HPVS/Thermal Control Module
HV	High Voltage
HVAC	Heating, Ventilating, and Air Conditioning (on ICE vehicles. For EV, see HPVS).
HWS	Heated Windshield
HWS	Hand Wheel Sensor
Hz	Hertz (cycles per second)
IC	Integrated Circuits
ICE	Internal Combustion Engine
IGBT	Isolate Gate Bipolar Transistor
I/O	Input(s)/Output(s)
IP	Instrument Panel
ISRV	Inside Rear View (mirror)
JB	Junction Block
KAM	Keep Alive Memory
kg	Kilogram
km	Kilometer
km/h	Kilometers per hour

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GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
kPa	Kilo Pascals
kW	Kilowatt
kWh	Kilowatt–hour
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
LHD	Left Hand Drive
LHJB	Left Hand Junction Block
LR	Left Rear
LVW	Loaded Vehicle Weight
m	Meter
MMC	Metal Matrix Composite (Rear Brake Drum Material)
MHz	Megahertz
mi	Mile(s)
MPH	Miles Per Hour
MSRP	Manufacturers Suggested Retail Price (includes dealer preparation)
MUX	Multiplex or Multiplexer
N	Newton(s)
NTF	No Trouble Found. Reported failure does not reoccur under test
OEM	Original Equipment Manufacturer
OSRV	Outside Rear View (mirror)
PCM	Propulsion Control Module (Drive Motor)
PDT	Portable Diagnostic Tool
PEB	Power Electronics Bay
PIM	Power Inverter Module
POA	Part of Assembly
PRND	Park–Reverse–Neutral–Drive, as in PRND Selector
PROM	Programmable Read Only Memory
PSOC	Pack State of Charge
PTC	Positive Thermal Coefficient. Term for resistive heating module
PWM	Pulse Width Modulation, or Pulse Width Modulated

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GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
QDM	Quad Driver Module
RAM	Random Access Memory
RAP	Retained Accessory Power
RF	Right Front
RF	Radio Frequency
RH	Right Hand
RH	Relative Humidity
RHJB	Right Hand Junction Block
RMS	Root-Mean-Squared
ROM	Read Only Memory
RP	Reduced Performance
RPM	Revolutions Per Minute
RR	Right Rear
RSA	Run/Lock Shifter Assembly
SAE	Society of Automotive Engineers
SDL	Serial Data Link
SDM	Sensor Diagnostic Module
SIR	Supplemental Inflatable Restraint (air bag) system
SLA	Short-Long Control Arm (suspension system)
SOC	State of Charge (battery pack). Usually expressed as a percentage
SN	Service Now
SSPO	Saturn Service Parts Operation
SS	Service Soon
SWA	Steering Wheel Angle
TNF	Trouble – Not Found. Reported failure reoccurs but cause cannot be determined
TJB	Trunk Junction Block
TOD	Time of Day
TPA	Terminal – Positive Assurance
T/S	Turn Signal
TT	Telltale

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GLOSSARY OF ACRONYMS CONTINUED

Acronym	Definition
UART	Universal Asynchronous Receiver – Transmitter (communications IC)
UH	Under Hood
ULEV	Ultra-Low Emissions Vehicle
USOL	User State of Charge
V5B	5 Volt Supply
VAC	Voltage, Alternating Current
VF	Vacuum Fluorescence
VH	Vehicle Handling
VIN	Vehicle Identification Number
VTD	Vehicle Theft Deterrent
W	Watt
WSS	Wheel Speed Sensor (part of ABS)
WSW	Windshield Washer/Wiper
ZEV	Zero Emission Vehicle

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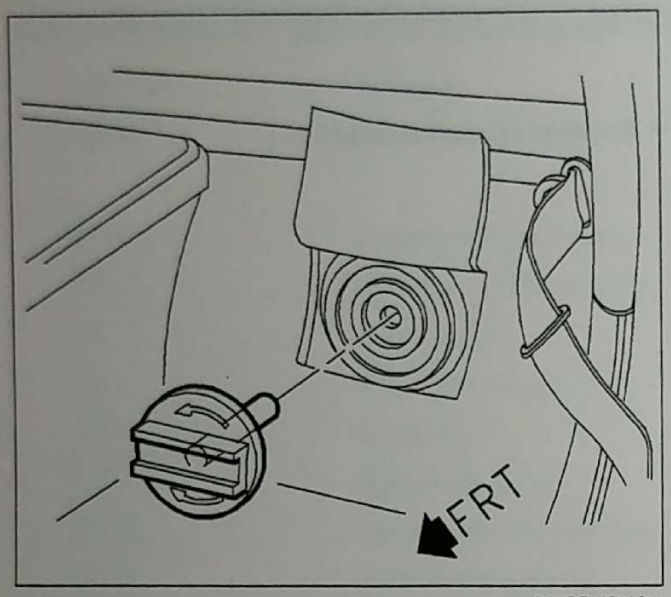

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HIGH VOLTAGE DISABLE

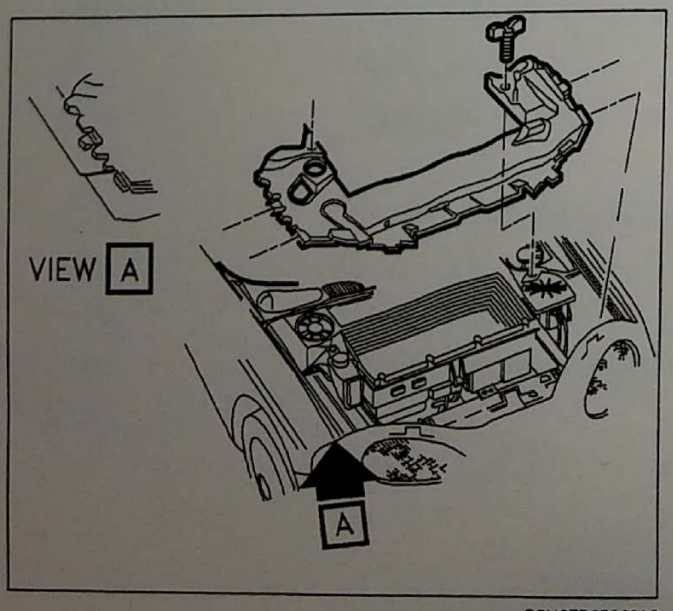
REMOVAL

CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.

1. Place the vehicle in the "RUN" mode.
2. Remove the manual disconnect knob.
   a. Tilt the drivers seat forward.
   b. Raise the carpet flap, located on the battery tunnel behind the drivers seat.
   c. Turn the manual disconnect knob counterclockwise and pull the manual disconnect knob straight out.

IMPORTANT: An audible click should be heard when turning the manual disconnect knob. This click indicates the automatic disconnect relays have opened.

3. Verify high voltage has been removed.
   a. Connect scan tool to the data link connector (DLC) and run the High Voltage special test. Battery pack module (BPM) diagnostic trouble codes (DTCs) 312, 280 and/or 275 should be present, which indicates BPM and auto disconnect recognized a high voltage disconnect.
   b. If test fails, refer to service manual "High Voltage Special Test Failed" in the "Battery and Charging System Service Manual."
4. Remove engine compartment sight shield.



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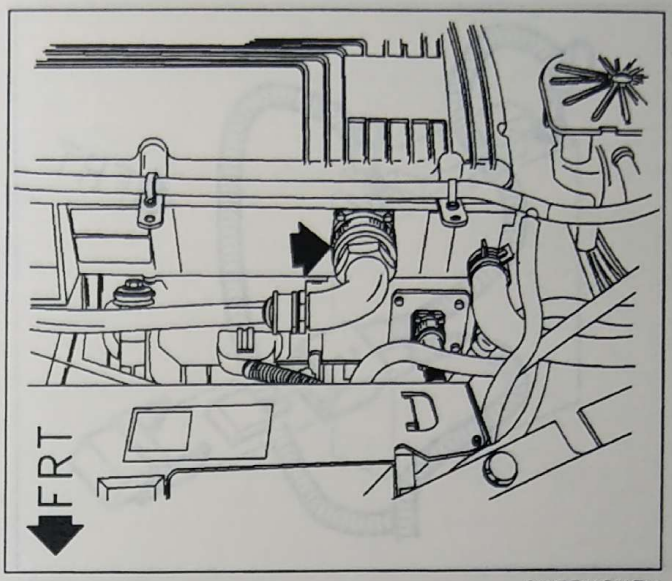
CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, ALWAYS ASSUME THE HIGH VOLTAGE IS PRESENT WHEN DISCONNECTING THE CHARGE RECEPTACLE TO PIM CONNECTOR. DO NOT ALLOW THE CONNECTOR BODY TO TOUCH THE PINS OF THE PIM WHEN REMOVING THE CONNECTOR.

5. Remove the charge receptacle to power inverter module (PIM) cannon connector using one hand.



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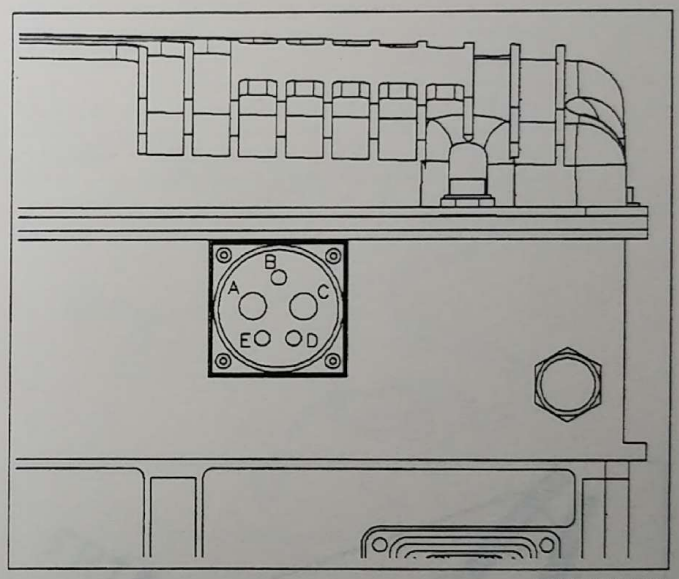
6. Using a DVOM and only one hand, measure from pin A of the PIM to chassis ground and from pin C of the PIM to chassis ground and from pin A to C. All measurements should be less than 10 volts. Pin C and Pin A are the large high voltage pins on the PIM.
   a. If the voltage is less than 10 volts, high voltage system is disabled.
   b. If the voltage is greater than 10 volts, refer to the "High Voltage" section in the "Battery and Charging Service Manual."



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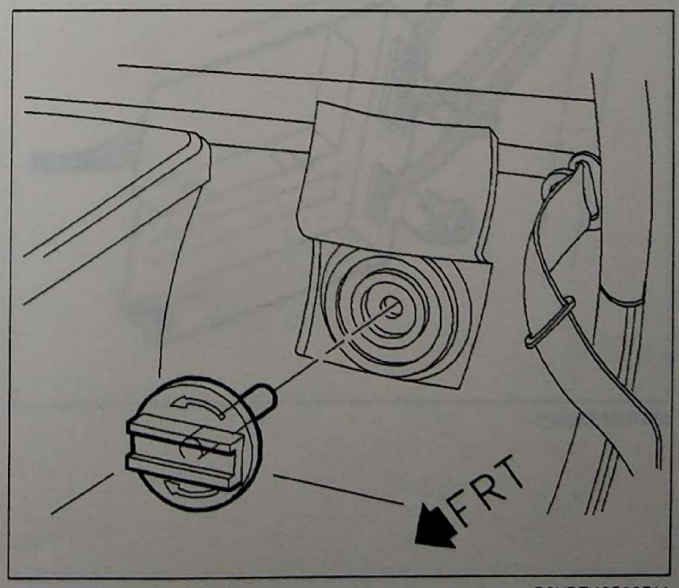
HIGH VOLTAGE ENABLE

INSTALLATION

1. Install charge receptacle to PIM cannon connector.
2. Install engine compartment sight shield.
3. Tilt driver's seat forward.
4. Raise the carpet flap, located on the battery tunnel behind the driver's seat.
5. Install the manual disconnect knob by pushing the shaft straight into the hole and turning clockwise.
6. Clear all DTCs using the scan tool.



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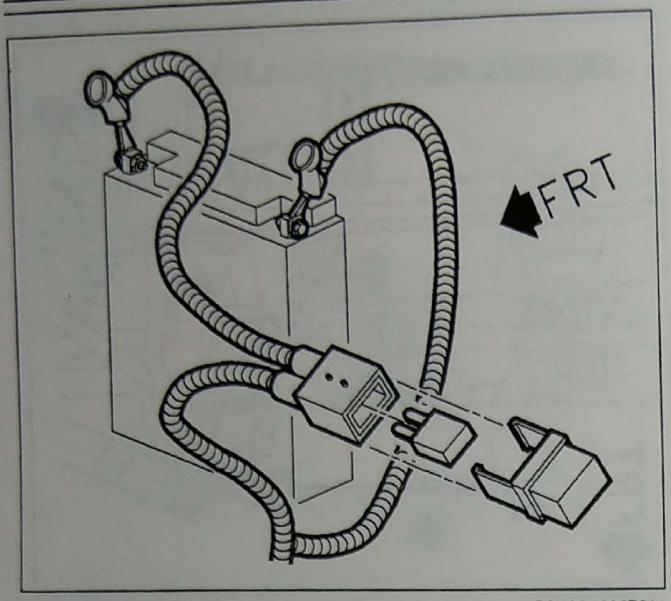

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12 VOLT SYSTEM DISABLE

CAUTION: DISABLE THE 12 VOLT ELECTRICAL SYSTEM TO HELP AVOID PERSONAL INJURY OR POSSIBLE DAMAGE.

IMPORTANT: The key pad must be in the LOCK mode for two minutes prior to performing the following step. Failure to do so could result in the loss of memory that retains the battery pack state of charge. If this occurs refer to "Battery Pack and Charging System" service manual for details.

1. Remove the cover on the 60 amp maxi fuse holder located in the negative auxiliary battery cable.
2. Remove the 60 amp maxi fuse.

12 VOLT SYSTEM ENABLE

1. Install 60 amp maxi fuse located on the negative auxiliary battery cable
2. Place cover on maxi fuse holder.

SIR SYSTEM

ON VEHICLE SERVICE

SERVICE PRECAUTIONS

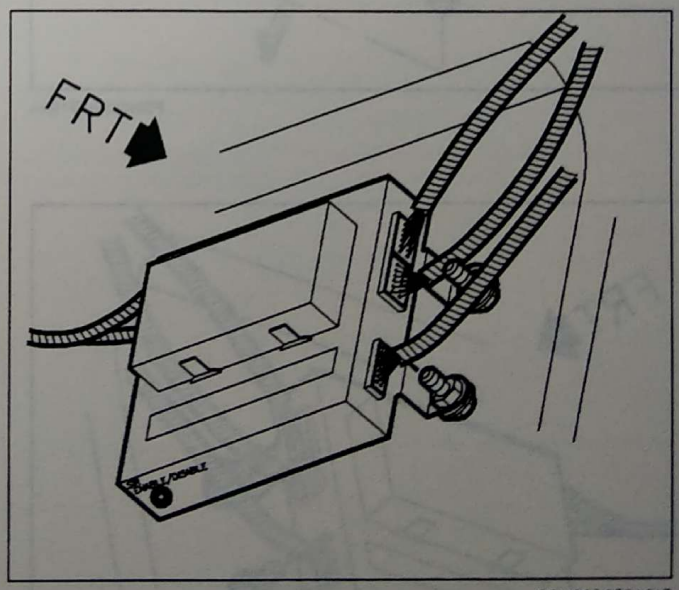
CAUTION: WHEN PERFORMING SERVICE ON OR AROUND SIR COMPONENTS OR SIR WIRING FOLLOW THE PROCEDURE BELOW TO TEMPORARILY DISABLE THE SIR SYSTEM. FAILURE TO FOLLOW PROCEDURES COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY OR OTHERWISE UNNEEDED SIR SYSTEM REPAIRS.

THE SENSING AND DIAGNOSTIC MODULE (SDM) CAN MAINTAIN SUFFICIENT VOLTAGE TO CAUSE A DEPLOYMENT FOR UP TO *10 MINUTES* AFTER THE KEY PAD HAS BEEN PLACED IN THE "LOCK" MODE, ALSO IF THE AUXILIARY BATTERY IS DISCONNECTED OR THE SIR "ENABLE/DISABLE" SWITCH IS PLACED IN THE DISABLE POSITION. MANY OF THE SERVICE PROCEDURES REQUIRE THE SIR "ENABLE/DISABLE" SWITCH TO BE PLACED IN THE "DISABLE" POSITION AND DISCONNECTION OF THE DEPLOYMENT LOOPS TO AVOID AN ACCIDENTAL DEPLOYMENT.

DISABLING THE SIR SYSTEM

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Place the key pad in the **LOCK** mode.
3. Place the SIR **"ENABLE/DISABLE"** switch in the right hand junction block in the **DISABLE** position.

IMPORTANT: With the SIR **ENABLE/DISABLE** switch in the **DISABLE** position and the key pad in the RUN mode, the AIR BAG telltale lamp will be "On." This is normal operation and does not indicate an SIR system malfunction.



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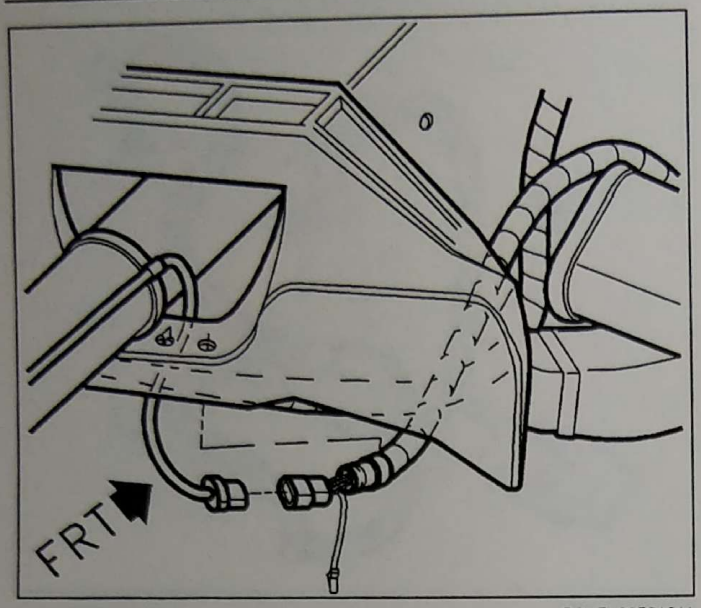

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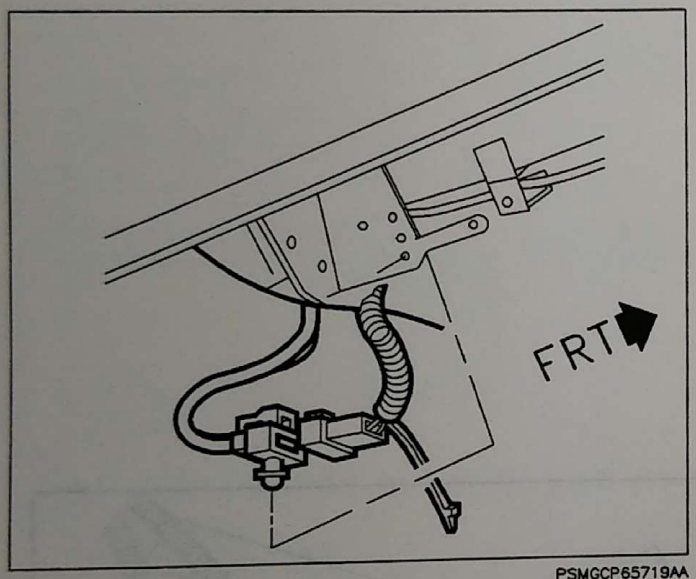
4. Remove connector position assurance (CPA) device and disconnect yellow two-way connector located near the base of the steering column.



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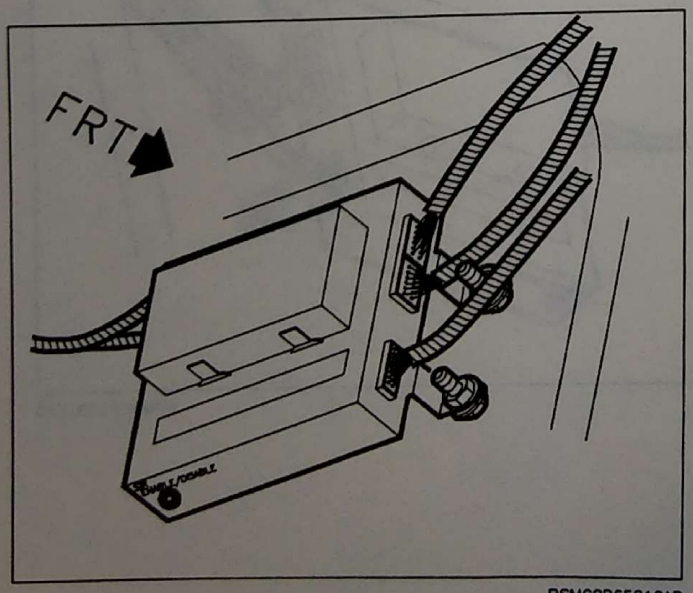
5. Remove connector position assurance (CPA) device and disconnect yellow two-way connector located on passenger inflator module pigtail under RH side of I/P.



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ENABLING THE SIR SYSTEM

1. Place key pad in the **LOCK** mode.
2. Connect yellow two-way SIR connector at the base of steering column and install connector position assurance (CPA) device to connector.
3. Connect yellow two-way passenger inflator module pigtail and install connector position assurance (CPA) to connector.
4. Place SIR **ENABLE/DISABLE** switch to the **ENABLE** position, located in the RH junction block.
5. Place key pad in the "RUN" mode and verify that the AIR BAG telltale lamp flashes seven times as the key pad is placed in the "RUN" mode and then goes Off. If lamp does not operate as described above perform the "SIR Diagnostic System Check" in this manual.

BRAKE SERVICE TOOLS

TOOL NUMBER	TOOL DESCRIPTION
EV9706S	Front Horizontal Bushing Removal/Installation
EV9707C	Electrohydraulic Power Steering Analyzer
EV9701Z	Power Steering – A/C Compressor Electrical Tester
EV9708E	Drive Motor Support Adaptor Kit
EV9711E	Drive Motor Support/Liftplate
EV9709S	Strut Spring Compressor Adaptor
EV9710S	Cradle to Body Alignment Tool
EV9716S	Front Stabalizer Link Socket
SA9132S	Lower Control Arm Ball Stud Separator
SA9304NE	Brake Pedal Effort Gauge
SA9217NE	Chassis Ear Tool
EV9713Z	Junction Blockground Strap

TOOL NUMBER	TOOL DESCRIPTION
EV9735Z	Digital Insulation Tester
SA9155S	Strut Spring Compressor
SA91107NE	Wheel Stud Remover
SA9218NE	Steering Wheel Puller
SA91108NE	Universal Tube Bender
SA9140E	Torque Angle Gauge
SA9150BR	Brake Bleeder Adapter
SA91100C	Tie Rod Separator
SA9193BR	Brake Line Flaring Kit
SA9209C	Inner Tie Rod Wrench
SA9201BR	Drum Brake Adjusting Tool
SA9164C	Steering Gear Clamp Installer
SA9105E	3 Bar Engine Support Fixture

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FASTENER USAGE

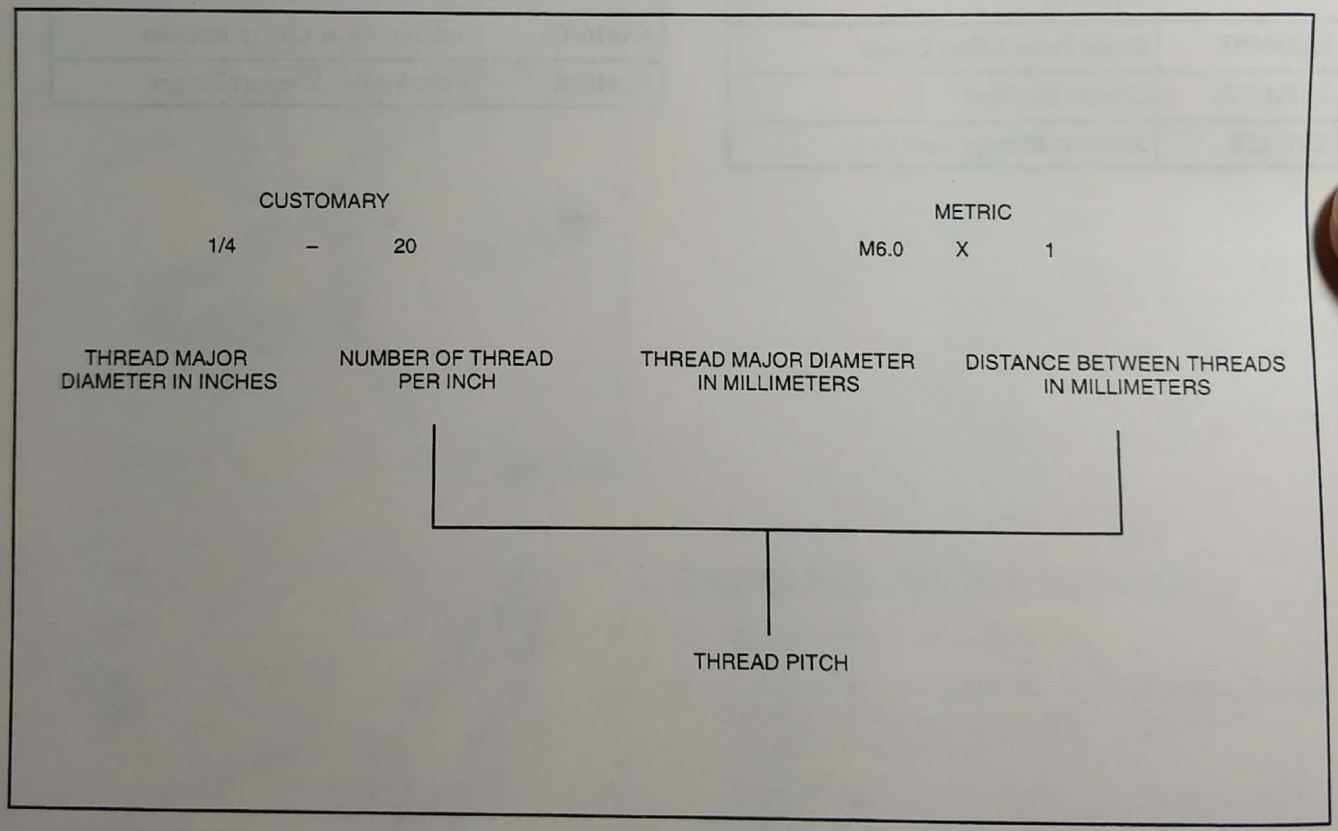
NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. Saturn Corporation will call out those fasteners that require replacement after removal. Saturn Corporation will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplement coatings (paint, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

All fasteners used on the EV1 are metric and are very close in dimension to well–known customary fasteners in the inch system. It is important that replacement fasteners have the correct nominal diameter, thread pitch, protective coating, and strength.

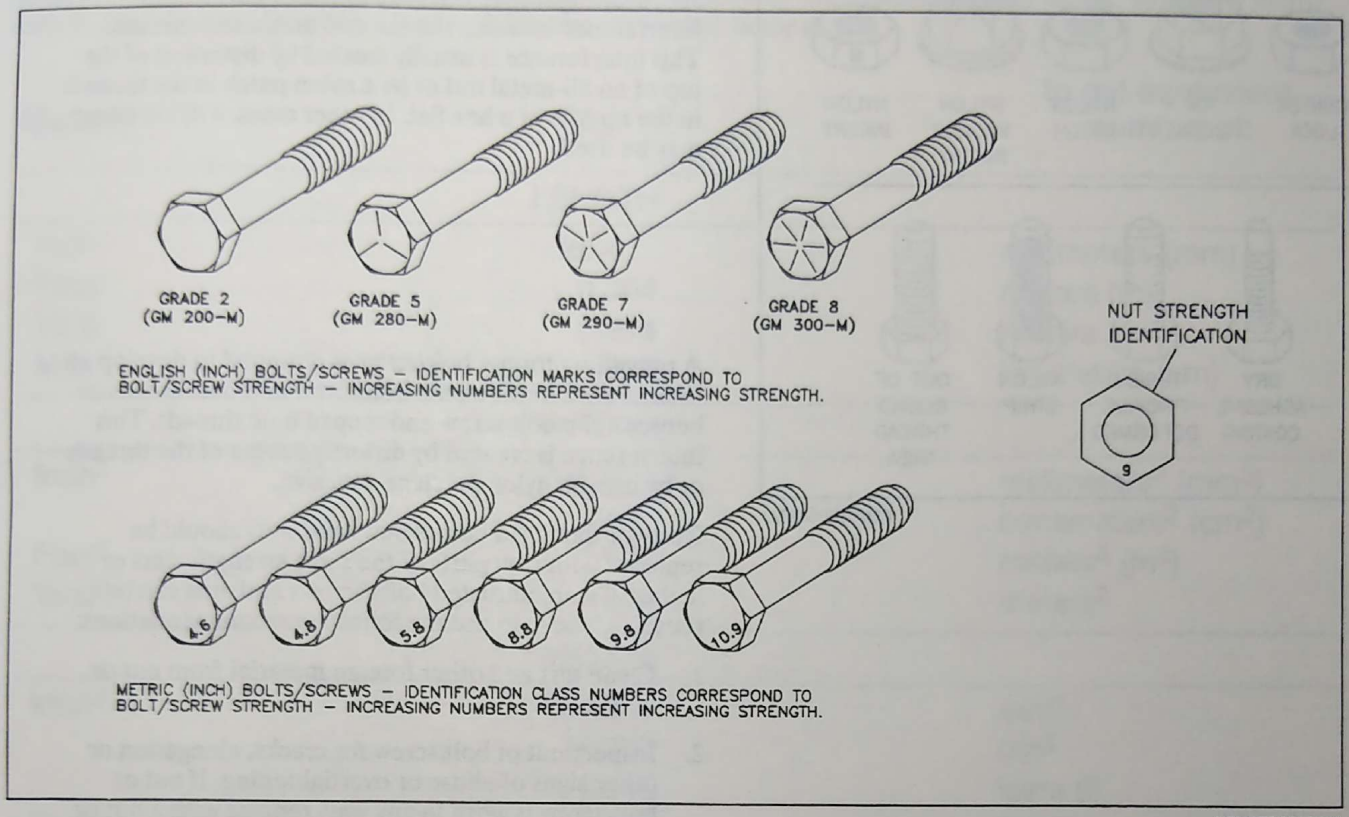
Original equipment metric fasteners, identified by a number marking, show the strength of the material on the fastener. Some beauty fasteners, such as exposed retainer clips and cross–recess head screws may not be identified.

The most commonly used metric strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Some metric nuts are marked with strength identification numbers on the nut face. It is extremely important to select replacement fasteners that are designed for the application. Each fastener has been selected to meet performance goals for each joint. The fastener strength, diameter, thread pitch, finish, length, head type and diameter are all equally important variables. Any deviation from the specified replacement part could jeopardize joint integrity.

Saturn Service Parts Organization (SSPO) is a supplier of high quality original equipment replacement fasteners for EV1. If fasteners are purchased from aftermarket suppliers, they must also posses the stringent quality requirements for use on the EV1



FASTENER STRENGTH IDENTIFICATION



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Most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt/screw. English fastener strength property classes range from grade 2 to 8. Radial lines are embossed on the head of each bolt/screw to identify the strength class. Some metric nuts are marked with strength identification numbers on the nut face.

When replacing fasteners, be careful to use bolts/screws and nuts of a strength class equal to, or higher than, the original fasteners (the same number marking or higher).

Also select replacement fasteners of the correct size. Correct replacement bolts/screws and nuts are available through Saturn Service Parts Operation (SSPO).

Many metric fasteners available in the aftermarket parts channels were designed to metric standards of countries other than the United States. The fasteners may have different strength or thread pitch and may not have the numbered head marking system. The metric fasteners used on GM products are designed to new international standards that might not be used by some nondomestic bolt/screw and nut suppliers.

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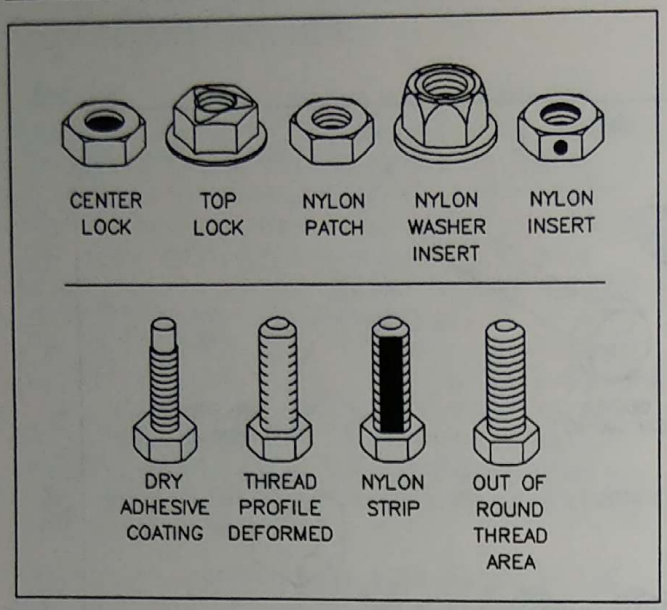

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PREVAILING TORQUE FASTENERS

A prevailing torque nut is designed to develop an interference between the nut and bolt/screw threads. This interference is usually created by distortion of the top of an all-metal nut or by a nylon patch in the threads in the middle of a hex flat. In other cases, a nylon insert may be used.

A prevailing torque bolt/screw is designed to develop an interference between the bolt/screw and nut threads or between the bolt/screw and tapped hole threads. This interference is created by distorting some of the threads or by using a nylon patch or adhesive.

Rusty or damaged bolts/screws and nuts should be replaced with new parts of the same strength class or higher. Clean, unrusted bolts/screws and nuts can be reused. Be sure to use the following recommendations:

1. Clean dirt and other foreign material from nut or bolt/screw.
2. Inspect nut of bolt/screw for cracks, elongation or other signs of abuse or overtightening. If nut or bolt/screw is worn in any way, replace with a nut or bolt/screw of the same strength class or higher.
3. Assemble the parts and hand-start nut or bolt-screw.
4. Check that nut or bolt/screw fails to develop the proper torque before it seats. If nut or bolt/screw fails to develop torque correctly, replace with a nut or bolt/screw of the same strength class or higher.
5. Tighten fastener to the torque specified in the appropriate installation procedure in this manual.

FASTENER TYPE	TORQUE UNITS	METRIC-SIZE FASTENERS							
		6	6.3	8	10	12	14	16	20
NUTS AND ALL METAL BOLTS/SCREWS	N•m	0.4	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	Lb. In.	4	4	7	12	19	27	37	62
ADHESIVE OR NYLON COATED BOLTS/SCREWS	N•m	0.4	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	Lb. In.	4	4	5	11	14	21	30	50
FASTENER TYPE	**TORQUE UNITS**	**INCH-SIZE FASTENERS**							
		.250	.312	.375	.437	.500	.562	.625	.750
NUTS AND ALL METAL BOLTS/SCREWS	N•m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	Lb. In.	4	5	12	16	21	28	37	55
ADHESIVE OR NYLON COATED BOLTS/SCREWS	N•m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	Lb. In.	4	5	9	12	16	23	30	49

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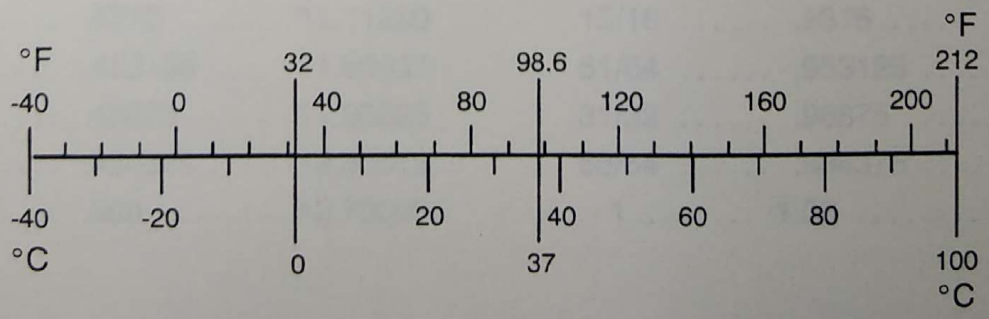
ENGLISH-METRIC CONVERSIONS

To convert English units to Metric units, multiply the English units by the conversion factor shown. To convert Metric units to English units, divide the Metric units by the conversion factor shown.

Multiply	by	to get equivalent number of:
	LENGTH	
Inch	25.4	millimeters (mm)
Foot	0.304	meters (m)
Yard	0.914	meters
Mile	1.609	kilometers (km)
	AREA	
$Inch^2$	645.2	$millimeters^2$ (mm^2)
	6.45	$centimeters^2$ (cm^2)
$Foot^2$	0.092	$meters^2$ (m^2)
$Yard^2$	0.836	$meters^2$
	VOLUME	
$Inch^3$	16 387.0	mm^3
	16.387	cm^3
	0.016	liters (l)
Quart	0.946	liters
Gallon	3.785	liters
$Yard^3$	0.764	$meters^3$ (m^3)
	MASS	
Pound	0.453	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278	newtons
Pound	4.448	newtons
	TEMPERATURE	
Degree Fahrenheit (°F)	(°F-32) ÷ 1.8	Degree Celsius (C)



ENGLISH-METRIC CONVERSIONS (CONTINUED)

Multiply	by	to get equivalent number of:
	ACCELERATION	
Foot/sec^2	0.305	meter/sec^2 (m/s^2)
Inch/sec^2	0.025	meter/sec^2
	TORQUE	
Pound-inch	0.113	newton-meters (N•m)
Pound-foot	1.356	newton-meters
	POWER	
Horsepower	0.746	kilowatts (kW)
	PRESSURE OR STRESS	
Inches of water	0.248	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
	ENERGY OR WORK	
BTU	1 055.	joules (J)
Foot-pound	1.356	joules
Kilowatt-hour	3 600 000. or 3.6 x 10^6	joules (1 joule = one watt–second)
	LIGHT	
Foot candle	10.76	lumens/meter^2 (lm/m^2)
	FUEL PERFORMANCE	
Miles/gal	0.425	kilometers/liter (km/l)
Gal/mile	2.353	liter/kilometer (l/km)
	VELOCITY	
Miles/hour	1.609	kilometers/hr. (km/h)

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DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In	Metric MM	Fractions	Decimal In	Metric MM
1/64	.015625	.39688	33/64	.51625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.17500	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

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SPECIFICATIONS

	mm	in
BRAKE PEDAL TRAVEL		
Brake pedal travel with 445 N (100 lbs.) force applied to pedal.*	50.80	2.0
REAR BRAKE DRUMS		
Runout	0.104	0.004
Inside Diameter	225.0	8.865
Discard Diameter**	226.0	8.916
Radial Runout (T.I.R.)	0.15	0.006
FRONT BRAKE ROTORS		
Lateral Runout	0.060	0.0024
Thickness Variation	0.013	0.0005
Diameter	245.0	9.65
New Thickness (Nominal)	11.0	0.44
Minimum Thickness After Refinish	9.3	0.37
Discard Thickness *	9.0	0.35
Scoring Depth	1.5	0.060

*Vehicle must be in the run mode for at least 10 seconds before applying brake.

**Brake drums and rotors have a discard diameter or thickness dimension cast into them. This is a wear dimension and not a refinish dimension. Any drum or rotor which does not meet the specification should be discarded.

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SPECIFICATIONS

	mm	in
BRAKE LININGS		
Front Disc Pads		
New Thickness	8.0	0.3152
Discard Thickness	1.0	0.0394
Rear Drum Shoes		
New Thickness	3.8	0.1378
Discard Thickness	0.254	0.010
FRONT CALIPER BORE DIAMETER	45.03	1.773
MASTER CYLINDER BORE DIAMETER	25.4	1.00
BRAKE SYSTEM FLUID CAPACITY	500ML	17.0 oz.
Master Cylinder Fluid Capacity	60ML	2.04 oz.
M/C Reservoir Fluid Capacity	306ML	10.40 oz.
Brake System Pipe and Hoses Fluid Capacity	80ML	2.72 oz.
HUB AND BEARING ASSEMBLIES		
Front		
End Play	0.130	0.005
Lateral Runout	0.038	0.0015
Rear		
End Play	0.130	0.005
Lateral Runout	0.038	0.015
Radial Runout	0.130	0.005

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LIFTING, JACKING, AND SUPPORT POINTS

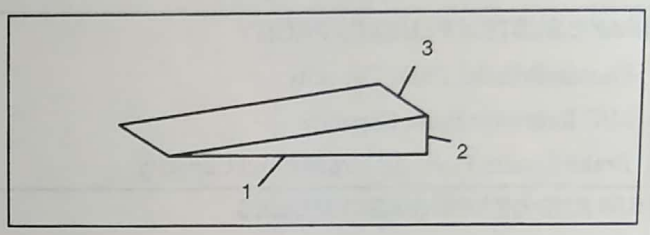
CAUTION: TO HELP AVOID PERSONAL INJURY WHEN A VEHICLE IS ON A HOIST, PROVIDE ADDITIONAL SUPPORT FOR THE VEHICLE. THIS WILL REDUCE THE POSSIBILITY OF THE VEHICLE FALLING OFF THE HOIST.

CAUTION: TO HELP AVOID PERSONAL INJURY, ALWAYS USE JACK STANDS WHEN WORKING ON OR UNDER ANY VEHICLE THAT IS SUPPORTED ONLY BY A FLOOR JACK OR A HOIST.

NOTICE: When lifting with a frame contact hoist, and battery pack removal is not necessary, lift the vehicle on the body side frame-lower pinch weld flanges at specific lift locations. (Location views on next page).

NOTICE: Because of the uniqueness of the design of the EV1 and its ground clearance, it is necessary to follow the hoisting directions very carefully. With an inground two post front and rear hoist, it may be necessary to use either low profile arms or ramps as needed in the front lift pad area to keep the fascia from being damaged when approaching or leaving the hoisting area. Ramp size needed:

1. **1050 mm in length (41-3/8 in.)**
2. **155 mm in height (6-7/64 in.)**
3. **230 mm in width (9-1/16 in.)**

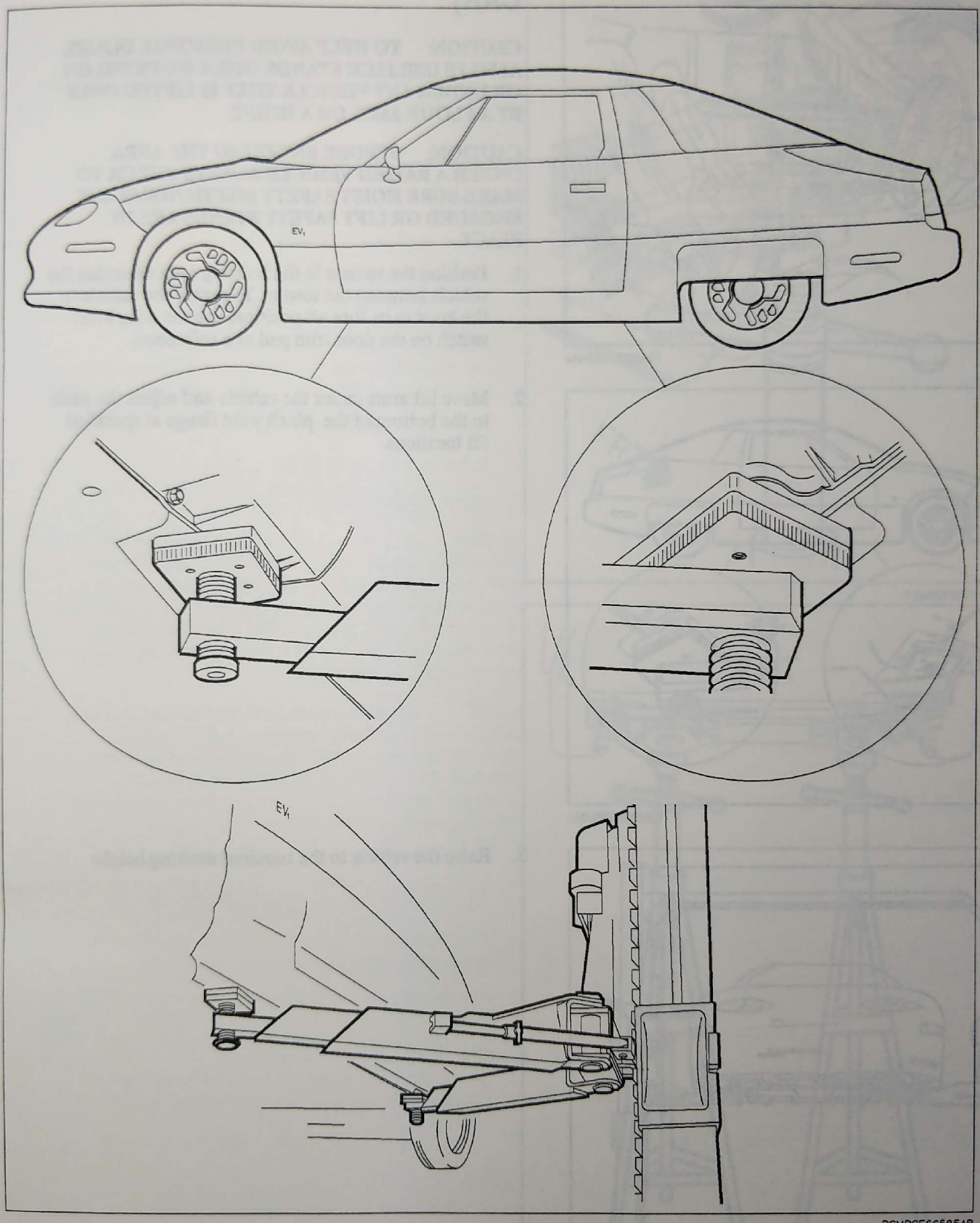


NOTICE: When lifting with a suspension contact hoist, position the front hoist lift pads under the lower control arms. Lift from under the rear tires for rear suspension. (Refer to "Hoisting/Lifting for a Two Post In Ground Hoist Front and Rear" in this section for more information and illustrations.)

When battery pack removal is required, the use of two rear lift pad adaptors must be used. These lift pad adaptors are obtainable from:

General Motors Dealer Equipment
Telephone: 1-800–GM–TOOLS

GENERAL INFORMATION



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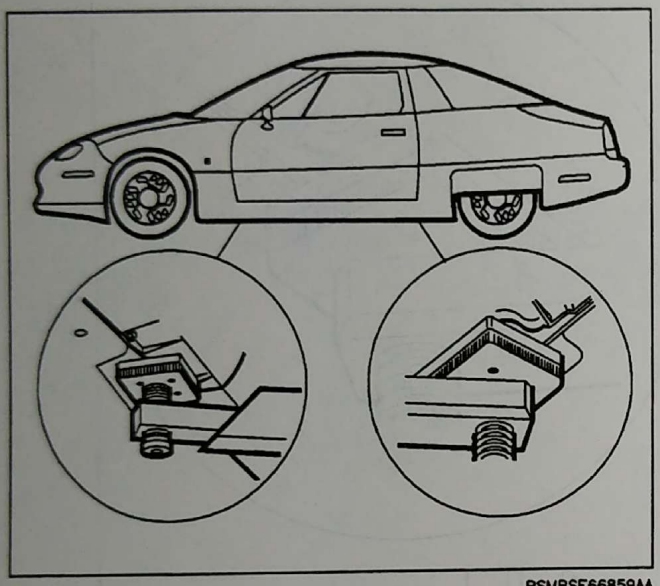

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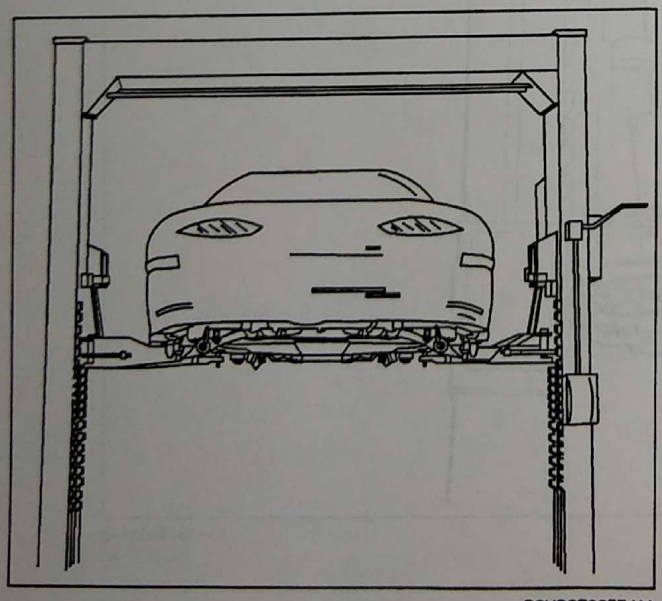

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HOISTING/LIFTING FOR A 2 POST ABOVE GROUND HOIST - (SIDE CAR)

CAUTION: TO HELP AVOID PERSONAL INJURY, ALWAYS USE JACK STANDS WHEN WORKING ON OR UNDER ANY VEHICLE THAT IS LIFTED ONLY BY A FLOOR JACK OR A HOIST.

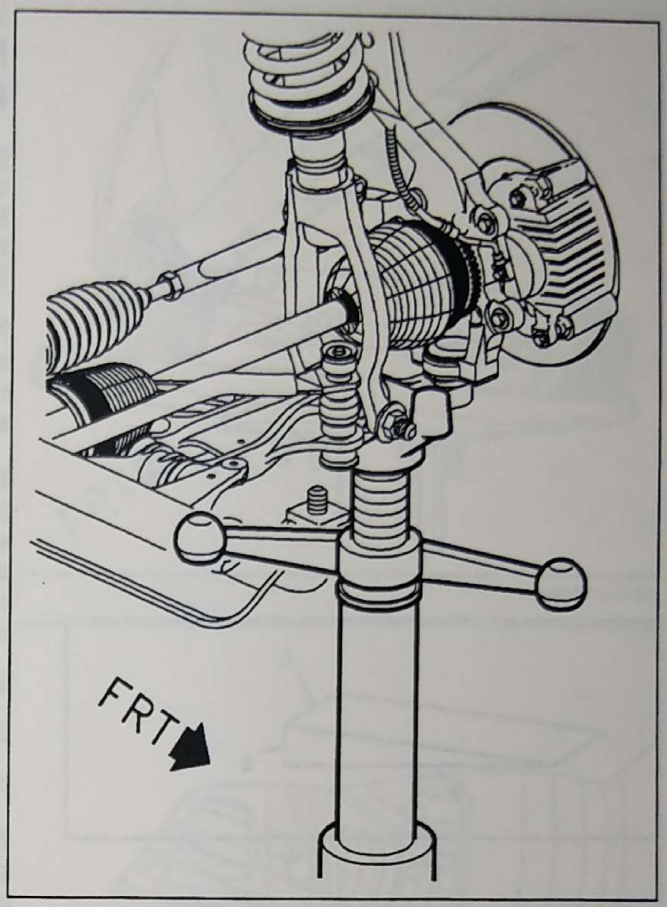
CAUTION: BEFORE ENTERING THE AREA UNDER A RAISED VEHICLE ALWAYS CHECK TO MAKE SURE HOIST SAFETY MECHANISMS ARE ENGAGED OR LIFT SAFETY STANDS ARE IN PLACE.

1. Position the vehicle in the hoisting area centering the vehicle between the towers. To center the vehicle to the hoist in its fore aft position, use the door lock switch on the door trim pad as a reference.

2. Move lift arms under the vehicle and adjust the pads to the bottom of the pinch weld flange at specified lift locations.

3. Raise the vehicle to the required working height

4. Position safety stands in place.



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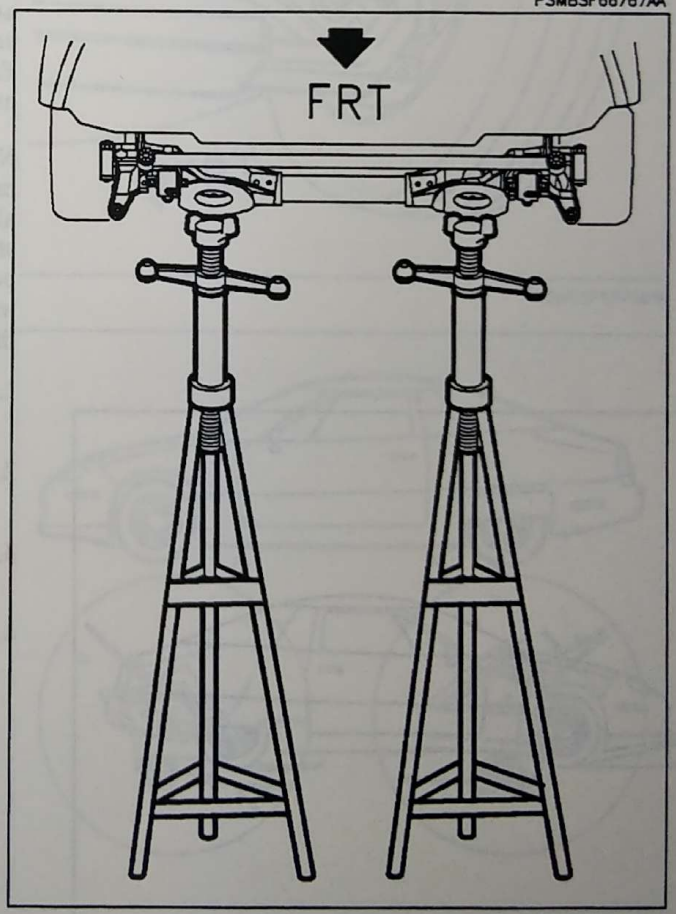

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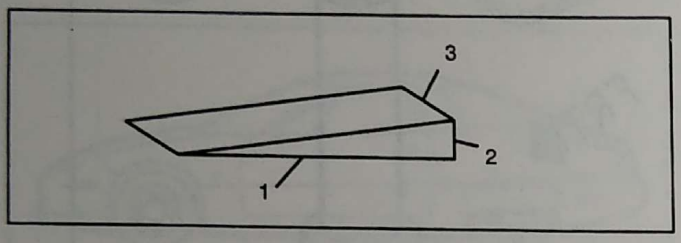
HOISTING/LIFTING FOR A 2 POST INGROUND HOIST - (FRONT AND REAR)

CAUTION: BEFORE ENTERING THE AREA UNDER A RAISED VEHICLE ALWAYS CHECK TO MAKE SURE HOIST SAFETY MECHANISMS ARE ENGAGED OR LIFT SAFETY STANDS ARE IN PLACE.

NOTICE: When using an in ground hoist it is necessary to pay close attention to the ground clearance at the front end of the vehicle. Be careful not to damage any of the front end components.

NOTICE: The aid of a ramp for some models of lifts is helpful for obtaining clearance under the front end of the vehicle. Proper clearance will keep the fascia and underbody components from being damaged when approaching or leaving the hoisting area. Ramp size needed:

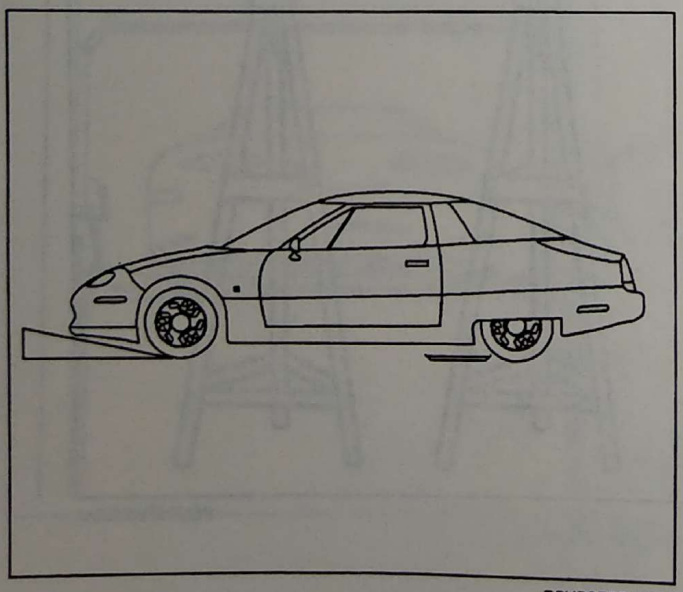


1. **1050 mm in length (41-3/8 in.)**
2. **155 mm in width (6-7/64 in.)**
3. **230 mm in height (9-1/16 in.)**

NOTICE: With the use of ramps, always have a partner who will be outside and in front of the vehicle guide and watch to ensure that proper alignment is achieved to the ramps and hoisting area. Be careful that you don't drive over or slip off the edge of the ramps. Failure to do so could result in damage to under body and mechanical components.

NOTICE: The first vehicle to be lifted using the ramp method may take several attempts to get properly aligned to the hoist pads under the front of the body structure. Marking the floor with tape, paint or permanent marker after the ramp position is determined will aid in the positioning ramps for future EV1 vehicle lifting.

1. Drive the vehicle up to the hoisting area, centering the vehicle to the hoist in its side to side position.
2. Drive vehicle forward until the front of the rear tires contact the rear edge of the rear tire lift tray.
3. Place the ramps on the floor. In front of the vehicle, center each ramp in front of the front tires.
4. Slide ramps rearward until they touch the front of the front tires, or align ramps to markings on floor made from previous lifting as described in the above **"NOTICE."**



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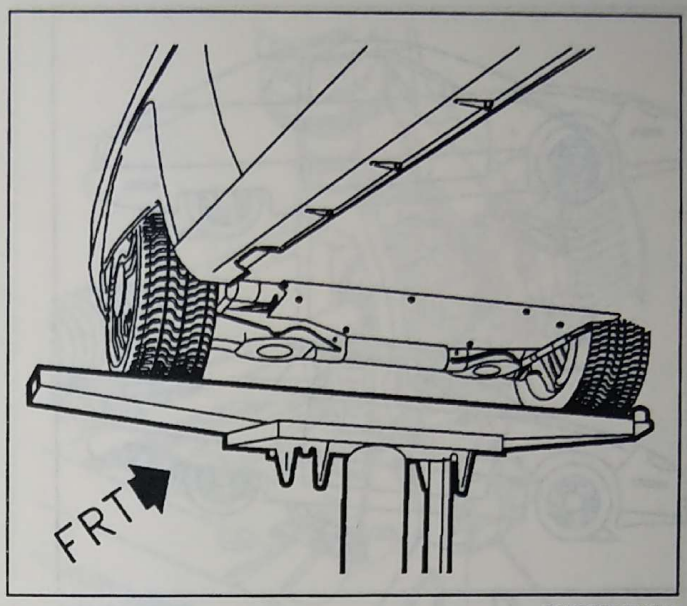
5. Drive forward and up the ramps until the rear tires are centered in the rear tire tray portion of the hoist.



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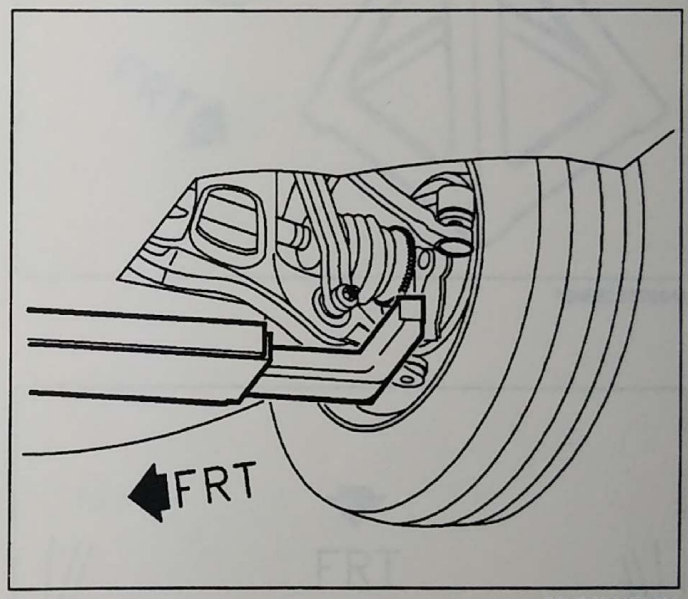
6. Put the front lift pads under the vehicle's front lower control arms at the portion between the ball joint and the yoke.
7. Lift the vehicle to proper working height and position safety stands. (Refer to "Lifting, Jacking, and Support Points" and "Hoisting Lifting with a Floor Jack" sections in this section.)



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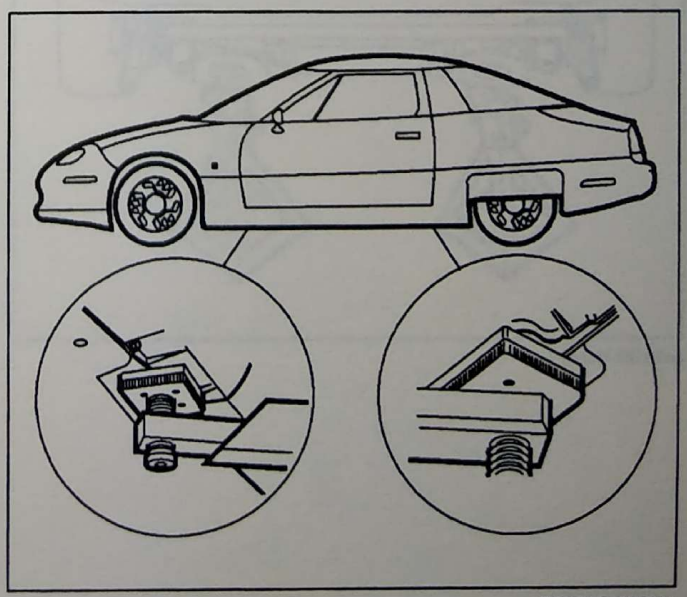
LIFTING WITH A FLOOR JACK.

NOTICE: Do not put floor jack under any portion of the vehicle other than locations shown or damage to the structure may occur.

1. Locate the rocker panel pinch weld flange lift/hoist areas, place floor jack in position, seat the lift pad in place, and chock the wheels. (Refer to "General Information" in the "Lifting, Jacking, and Support Points" section in this section.)



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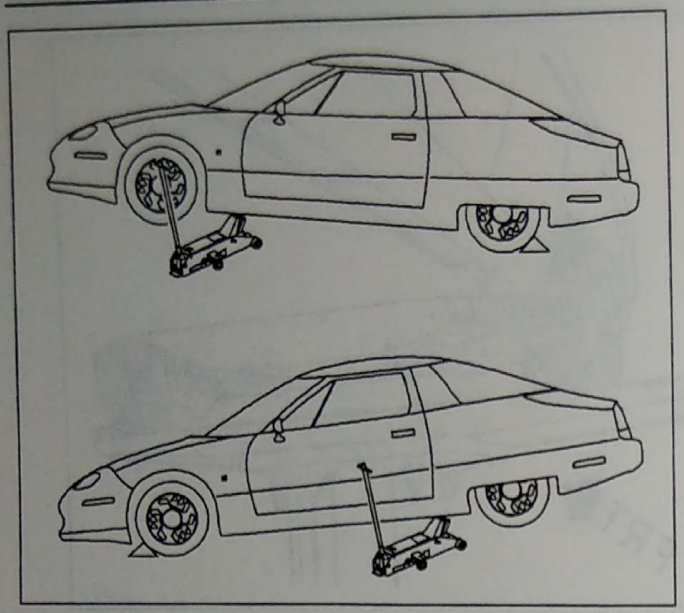

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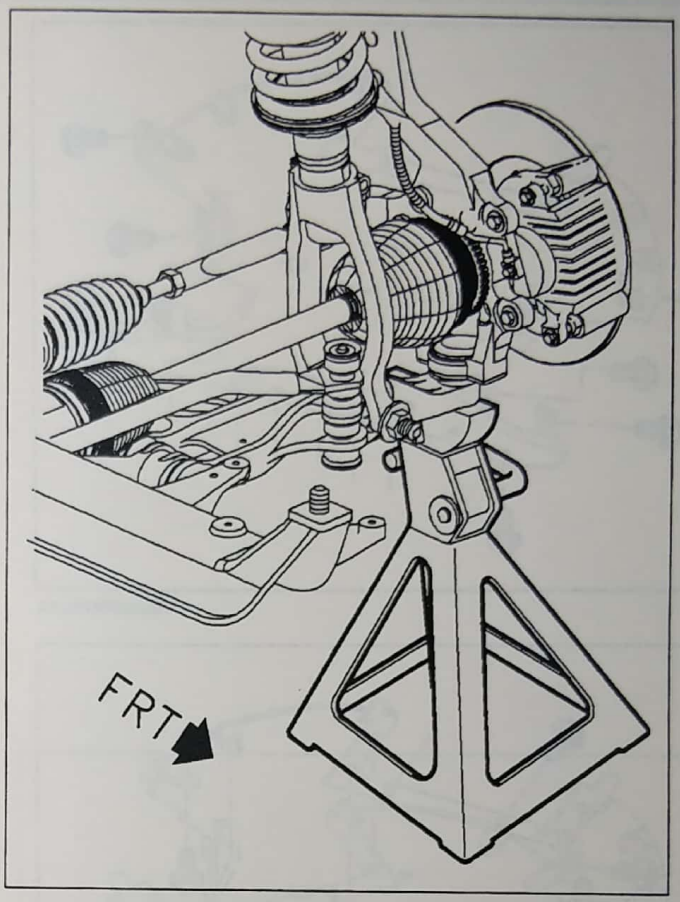
CAUTION: TO HELP AVOID PERSONAL INJURY, ALWAYS USE JACK STANDS WHEN WORKING ON OR UNDER ANY VEHICLE THAT IS SUPPORTED ONLY BY A FLOOR JACK OR A HOIST.

2. Lift vehicle with floor jack.

3. Once the vehicle is at the required working height install safety stands.



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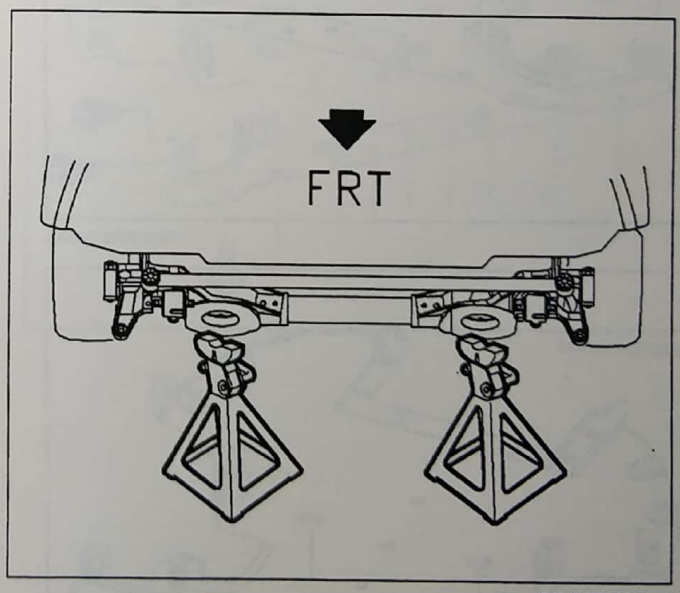

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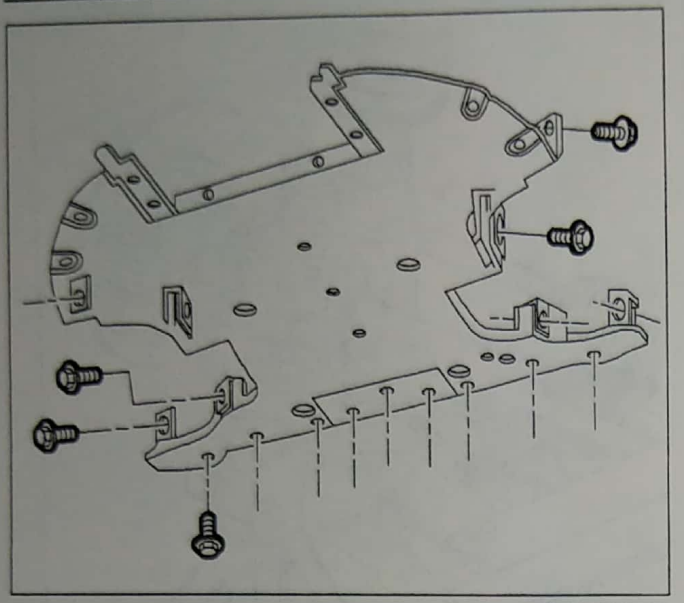
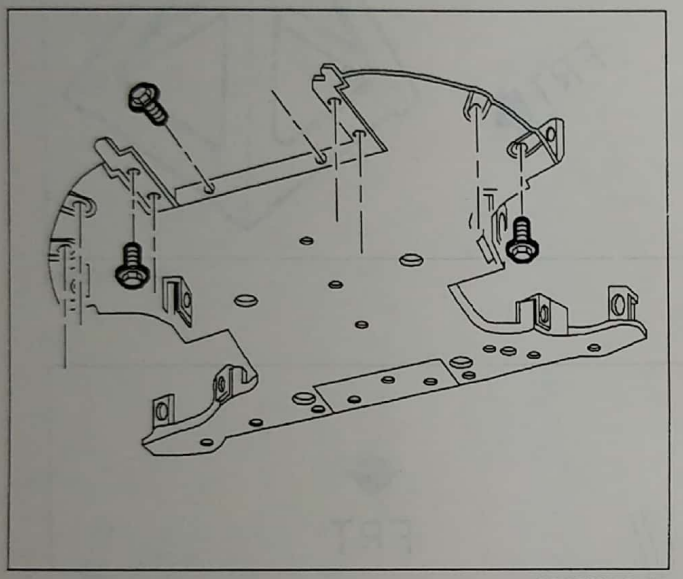


PSMGEP67582AA

UNDERBODY FRONT AIR DEFLECTOR

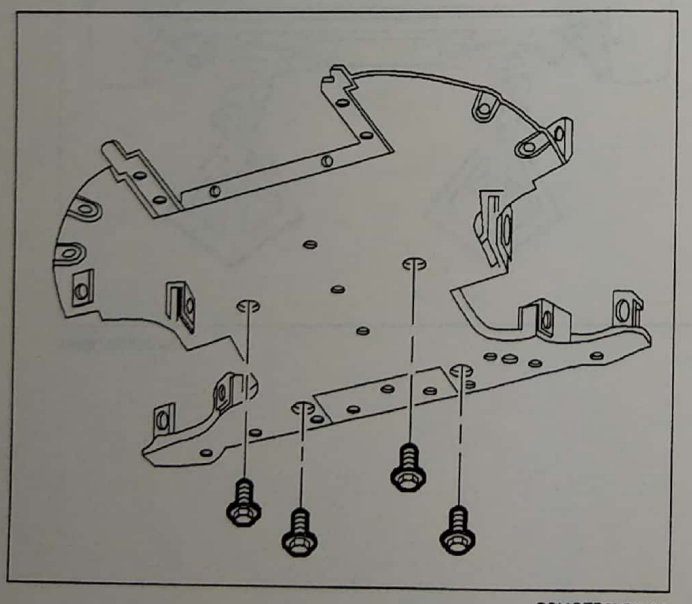
REMOVAL

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" section in this manual.)
2. Remove bolts retaining underbody front air deflector to underbody center air deflectors.
3. Remove bolts retaining underbody front air deflector to front wheelhouse panel liners.



PSMGEP67583AA

4. Remove bolts retaining underbody front air deflector to front bumper fascia assembly.
5. Remove bolts retaining underbody front air deflector to condenser radiator fan module (CRFM) bracket.



PSMGEP67581AA

6. Remove bolts retaining underbody front air deflector to side baffles.
7. Remove bolts retaining underbody front air deflector to drivetrain and front suspension crossmember assembly.
8. Lower underbody front air deflector and disengage tabs from front bumper fascia assembly.

INSTALLATION

IMPORTANT: If bolt threads or "J" nuts threads are damaged during removal or installation, remove bolt and fastener, inspect, and replace if necessary.

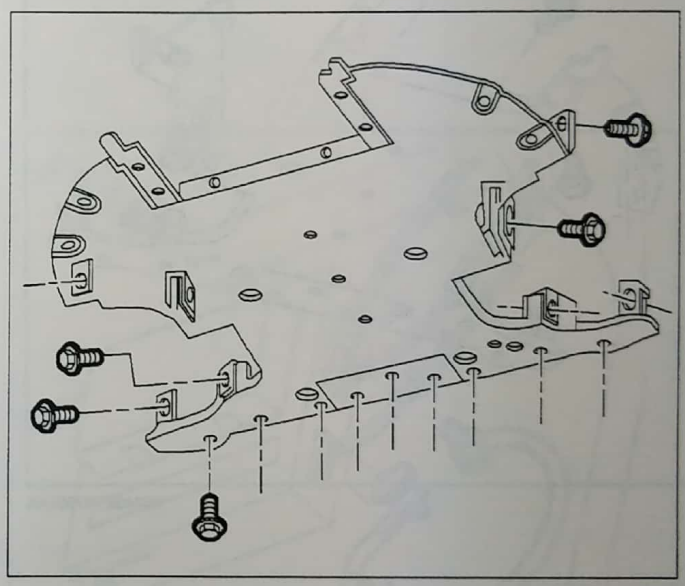
1. Raise front edge of air deflector and engage tabs into retaining slots on front bumper fascia assembly.
2. Raise and support underbody front air deflector to underside of vehicle.

IMPORTANT: Flange on air deflector must be located forward of Condenser Radiator Fan Module (CRFM) bracket.

3. Loosely install bolt retaining air deflector to CRFM bracket.
4. Loosely install bolts retaining underbody front air deflector to front mounting locations of drivetrain and front suspension crossmember assembly.
5. Loosely install bolts retaining underbody front air deflector to rear mounting locations of drivetrain and front suspension crossmember assembly.
6. Install and tighten bolts retaining underbody front air deflector to underbody center air deflectors. Torque as specified.

Torque: 6 N•m (53 in–lbs)

IMPORTANT: If cradle bolt begins to cross thread during installation, stop immediately, remove bolt, then run thread tap (M6.0 mm x 1.0) into insert to repair damaged threads.



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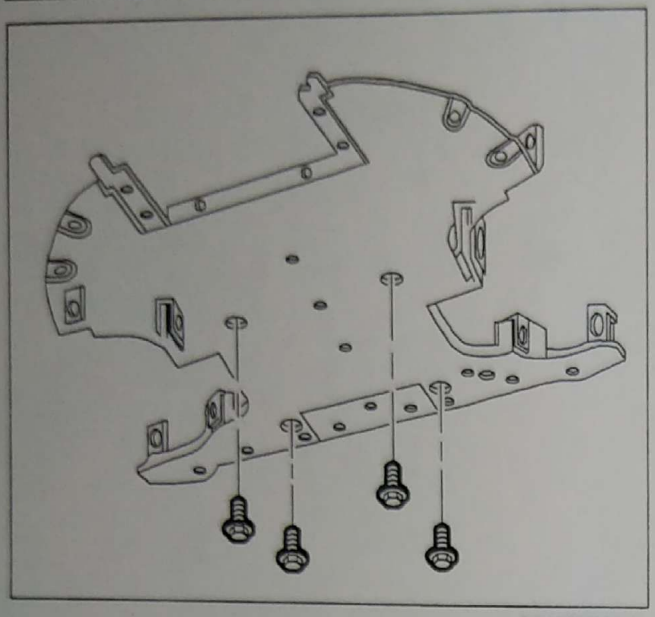

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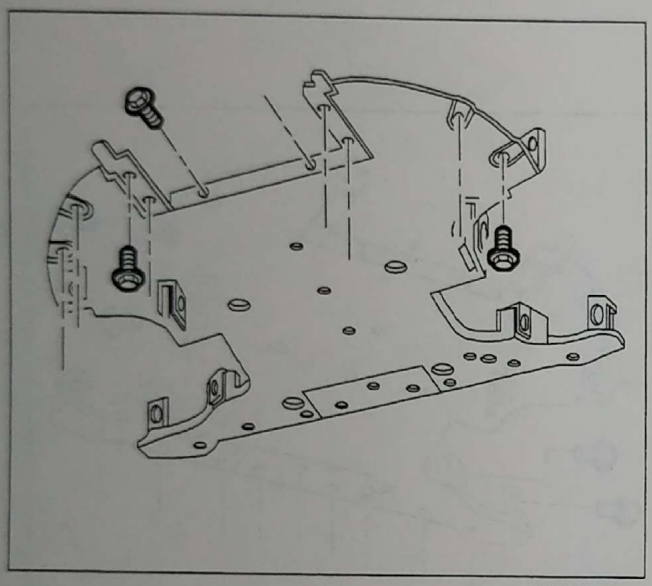
7. Tighten bolts retaining underbody front air deflector to front mounting locations of drivetrain and front suspension crossmember assembly. Torque as specified.

Torque: 6 N•m (53 in–lbs)



PSMGEP67583AA

IMPORTANT: At CRFM attachment, position air deflector flange so that it rests up against the bottom of the CRFM lower support.

8. Install and tighten bolt retaining underbody front air deflector to CRFM bracket. Torque as specified.

Torque: 6 N•m (53 in–lbs)

9. Tighten remaining bolt retaining air deflector to CRFM bracket. Ensure underbody front air deflector is up against bottom of CRFM lower support. Torque as specified.

Torque: 6 N•m (53 in–lbs)

10. Install and tighten bolts retaining underbody front air deflector to CRFM to fascia close-out side baffles. Torque as specified.

Torque: 6 N•m (53 in–lbs)

11. Install and tighten bolts retaining underbody front air deflector to front bumper fascia assembly. Torque as specified.

Torque: 6 N•m (53 in–lbs)

12. Install and tighten bolts retaining underbody front air deflector to front wheelhouse panel liner on one side of the vehicle. Front tires may need to be rotated to access mounting locations. Torque as specified.

Torque: 6 N•m (53 in–lbs)

13. Install and tighten bolts retaining underbody front air deflector to front wheelhouse panel liner on opposite side of the vehicle. Front tires may need to be rotated to access mounting locations. Torque as specified.

Torque: 6 N•m (53 in–lbs)

14. Lower vehicle and turn front wheels to face in a straight ahead position.

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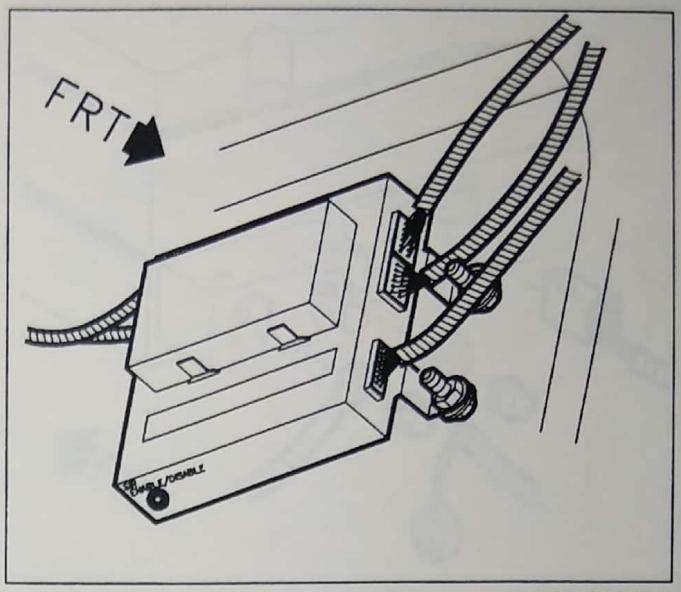
JUNCTION BLOCK GROUND STRAP INSTALLATION / REMOVAL PROCEDURE

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap Installation" in this manual.)

INSTALLATION

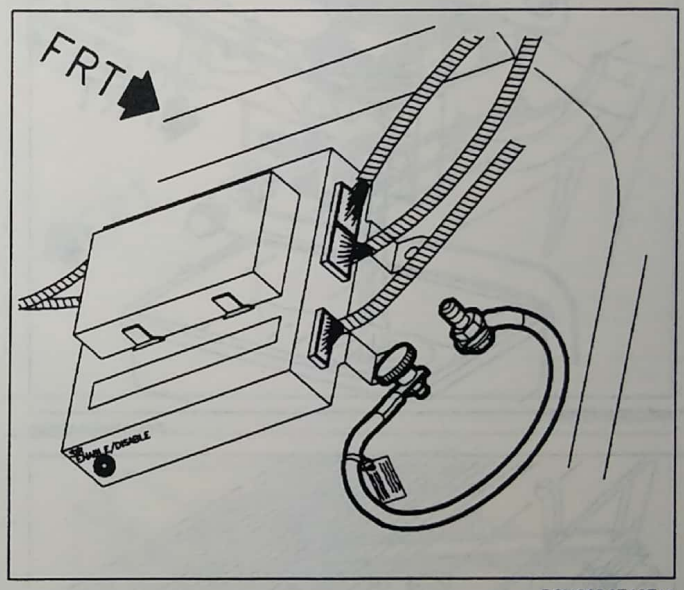
1. Place key pad in LOCK mode.
2. Remove the four fasteners that retain the RH or LH junction block.
3. Install junction block ground strap/straps to junction block using the captured fasteners as illustrated and tighten to 10 N•m +/− 2 N•m (89 in−lbs +/− 18 in−lbs).
4. Install the loose end of the junction block ground strap to the junction block mounting stud on front dash, using the existing nut.



PSMGCP65816AB

REMOVAL

1. Remove the junction block ground strap from the junction block, RH and LH sides if necessary.
2. Mount the junction block to the front of dash and torque to 10 N•m +/− 2 N•m (89 in−lbs +/− 18 in−lbs).



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POWER ELECTRONICS BAY (PEB)

REMOVAL

CAUTION: TO REDUCE THE RISK OF SEVERE SHOCKS AND BURNS, THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT, ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.

1. Disable high voltage. (Refer to "High Voltage Disable" in this service manual.)
2. Disable 12 volt system. (Refer to "12 Volt System Disable" in this service manual.)

IMPORTANT: Do not remove expansion tank cover or open cooling system drains from a hot system. allow system to cool first.

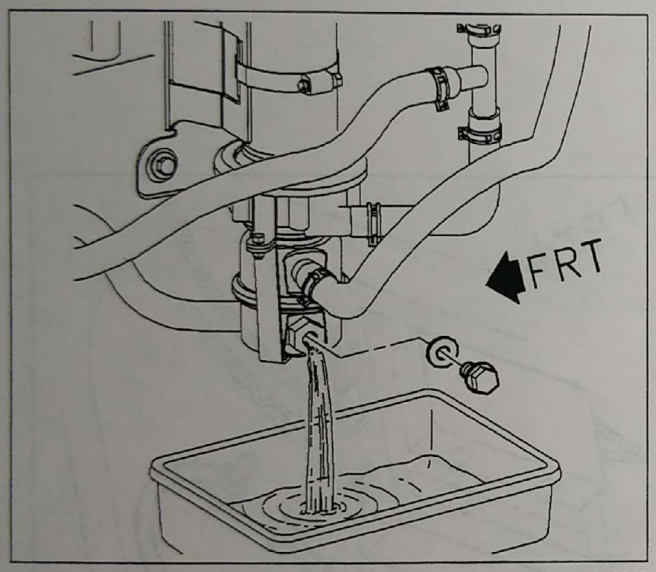
3. Remove the expansion tank cover.
4. Raise the vehicle on a hoist. (Refer to "Lifting, Jacking, and Hoisting" section in this manual.)
5. Remove front underbody air deflector. (Refer to "Front Underbody Air Deflector Removal" procedure in this manual.)
6. Position drain pan under water pump manifold.

IMPORTANT: A two gallon container will be required to hold the coolant.

7. Remove the drain plug and gasket from the water pump manifold allowing the coolant to flow from the main path.
8. After coolant has drained from the main path, reinstall water pump manifold drain plug and gasket.

Torque: 11 N•m (97 in−lbs)

9. Lower vehicle.
10. Disconnect the battery assembly to power inverter module (PIM) cannon connector from the right rear corner of the PEB.



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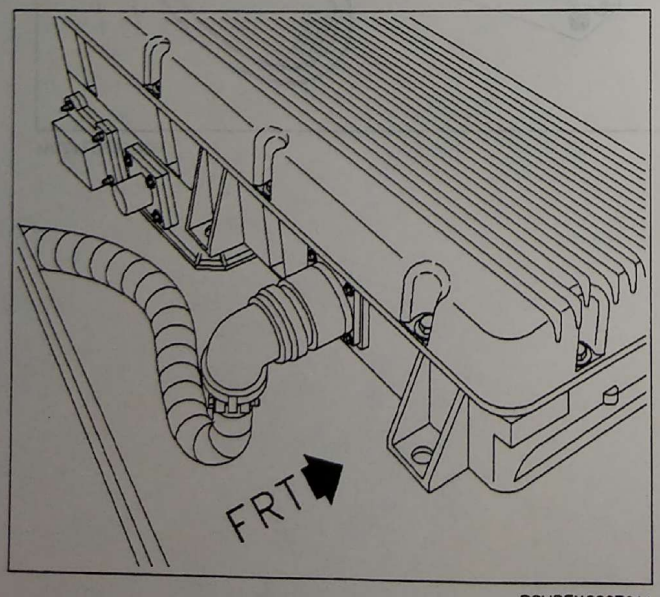
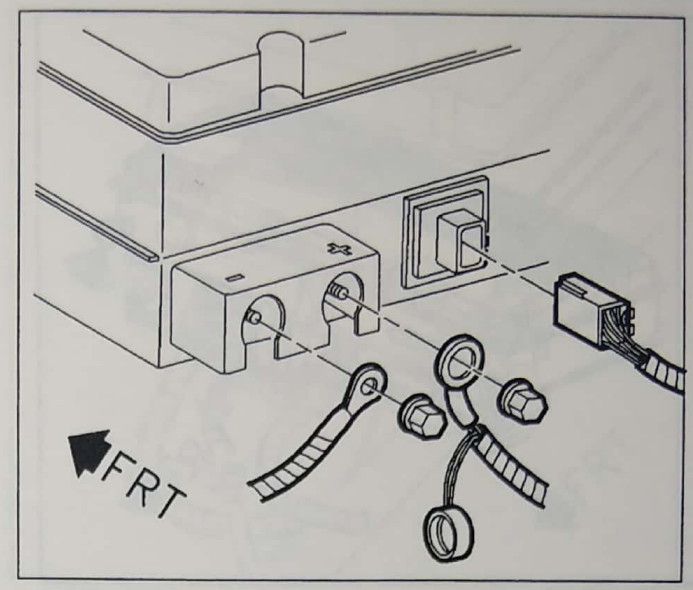


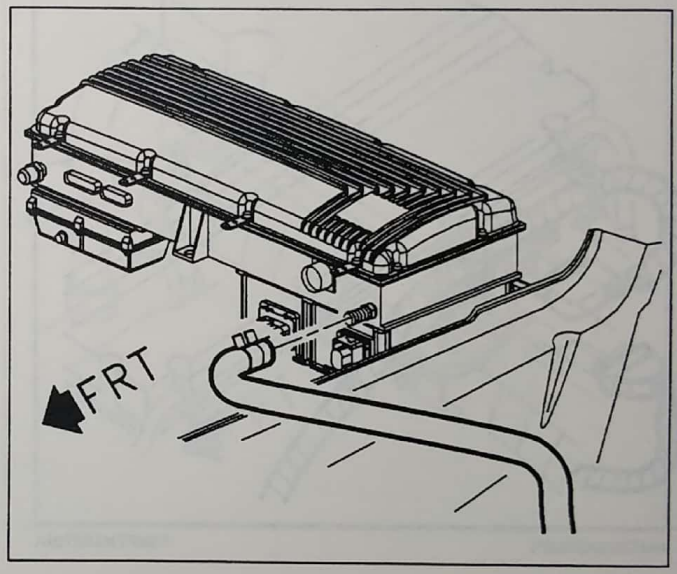
PSMPEN66279AA

11. Disconnect the accessory AC and DC power control module (APM) 5−way connector from the rear of the PIM.
12. Remove the negative and positive battery cables from the PIM. Voltage should not be present at these connections. If voltage is present verify that all steps of low and high voltage disable have been completed.



PSMPEN66019AA

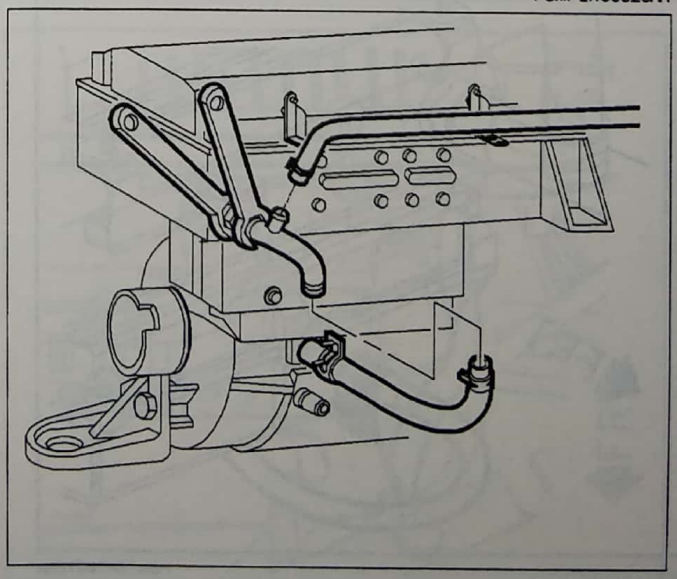
13. Disconnect the driver side coolant hose from the PIM.



PSMPEN66020AA

NOTICE: Always use a wrench to back up the opposing fitting when disconnecting connections. Failure to use a wrench to back up fittings could cause distortion of connections, fittings or components

14. Disconnect the passenger side coolant hose from PIM only.



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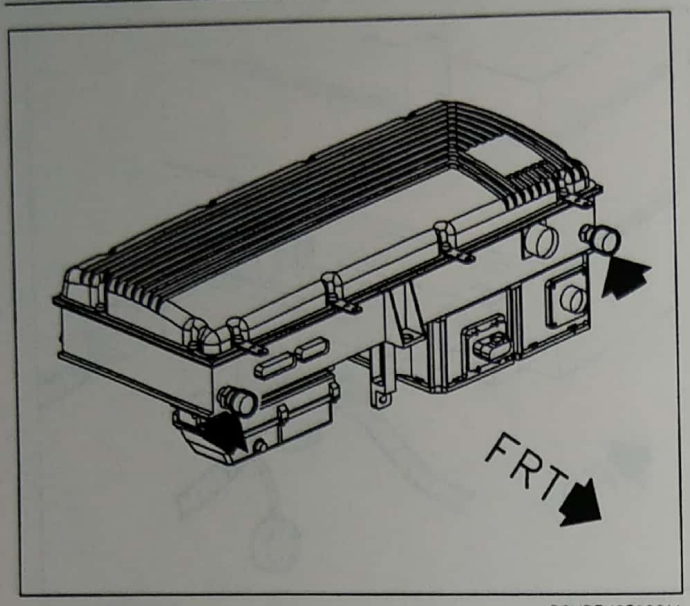
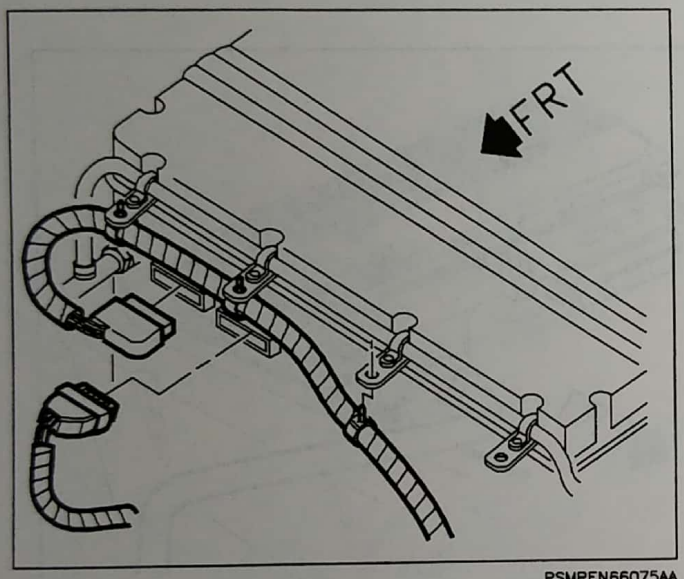


PSMPEN65996AA

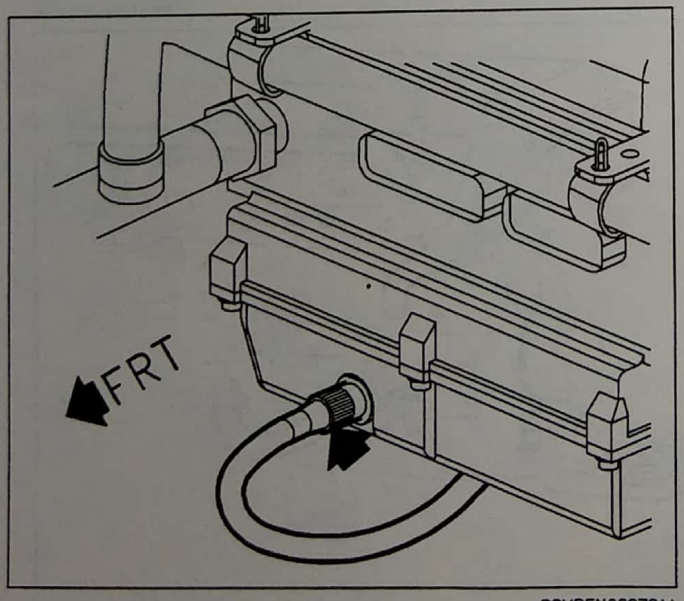
15. Install coolant plugs to prevent coolant leakage during removal.

IMPORTANT: If coolant plugs are not available, tape the cooling fittings.



PSMPEN66075AA

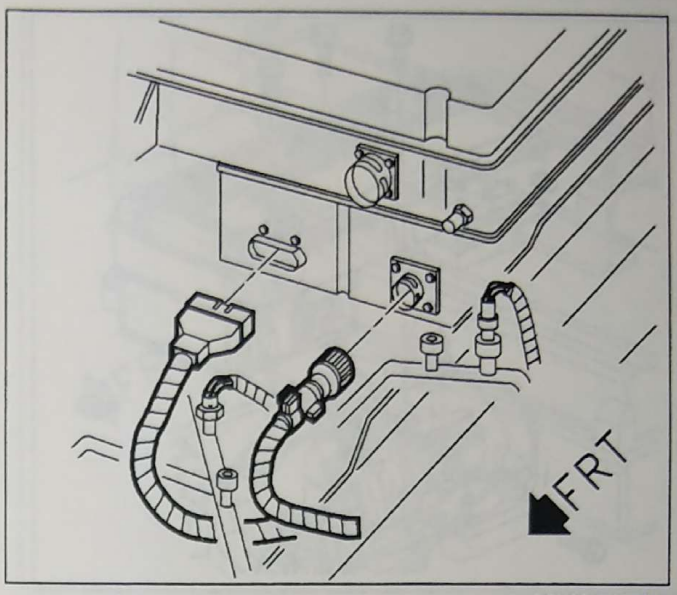
16. Remove the 32−way and the 24−way connectors at the forward right corner of the PIM. To remove the connectors squeeze the connector retainer and pull outward.



PSMPEN66278AA

17. Disconnect the power steering control module (PSCM) 5−way connector at the PSCM.

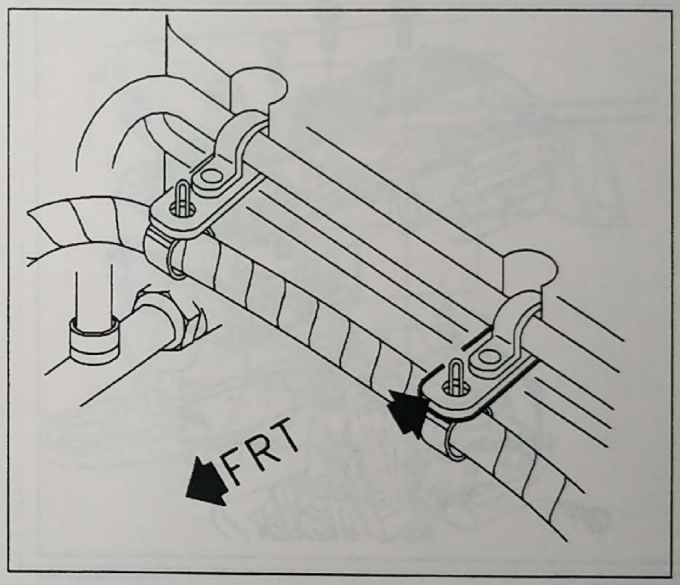
18. Disconnect the accessory AC and DC power control module (APM) 24−way and small cannon connector at the forward left side of the APM.



PSMGCH66073AA

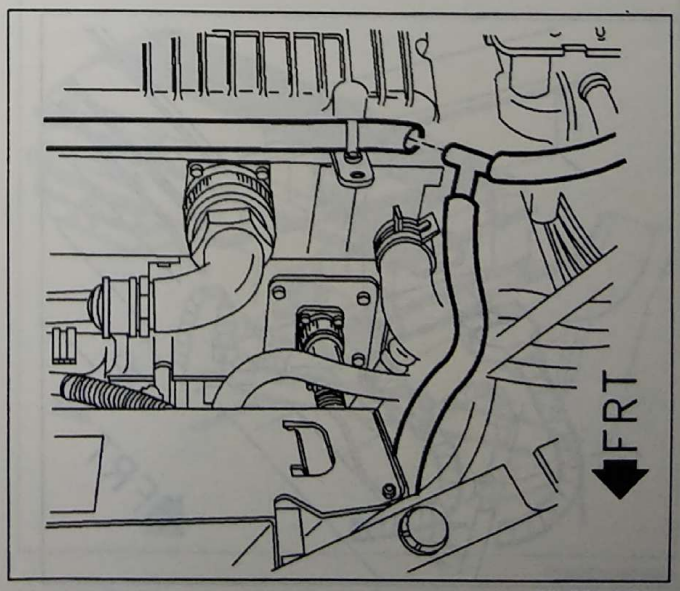
IMPORTANT: Do not remove the PIM top cover screws.

19. Remove the wire clips retaining the PEB harness to the front PIM cover brackets and remove the PEB harness away from the PEB.

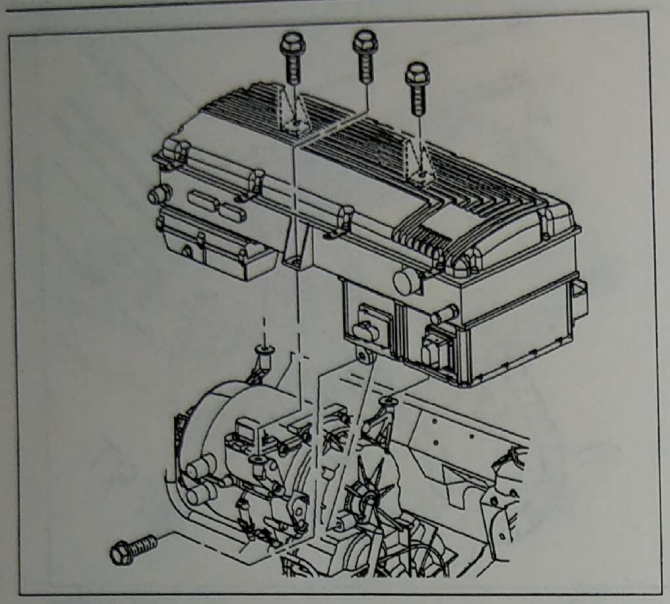


PSMPEN66074AA

20. Remove the coolant hose at the "T" going into the expansion tank.

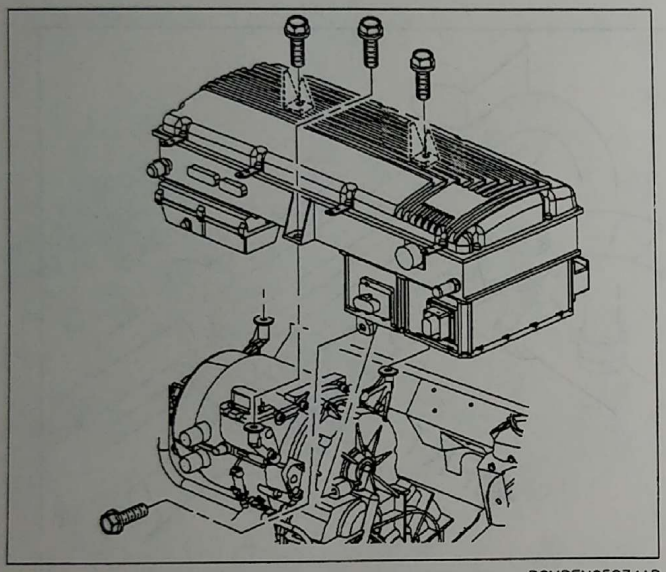


PSMPEN66021AA



PSMPEN65834AB

21. Remove the lower PEB to drive unit bolt located just to the right of the PEB center, below the top of the engine strut.
22. Remove the remaining PEB to drive motor bolts.
23. Using two people, one at each end of the PEB lift the assembly straight up disconnecting it from the drive motor and continue lifting until the lower attachment tab clears the front of vehicle. Remove the PEB.



PSMPEN65834AB

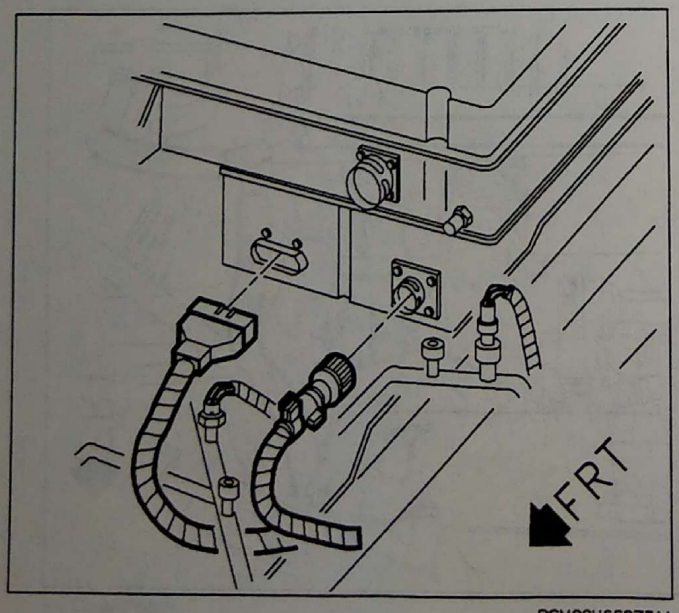
INSTALLATION

1. Using two people position the PEB over the drive motor connection point. Carefully lower the PEB over the drive motor and into position.
2. Install the top PEB to drive motor bolts. Lightly tightened all bolts.
3. Install the lower PEB to drive motor bolt located just to the right of the PEB center, below the top of the engine strut.

Torque: 35 N•m (26 ft−lbs)

4. Torque the top PEB to motor bolts

Torque: 63 N•m (46 ft−lbs)



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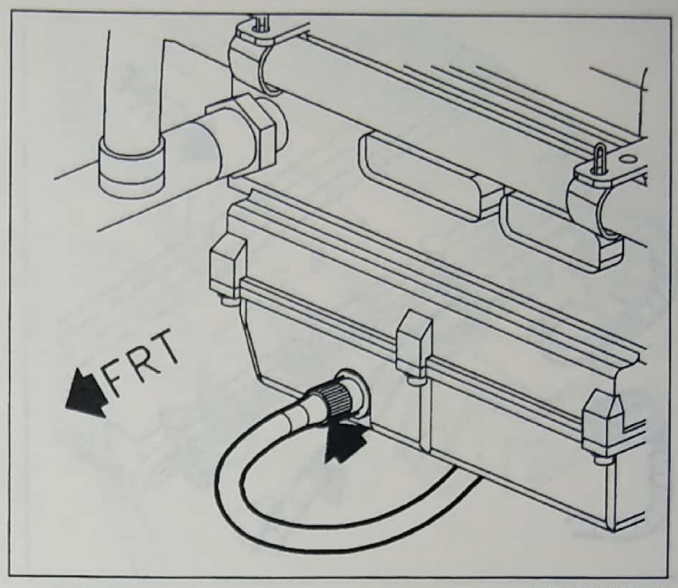
5. Connect the APM 24−way connector and the APM cannon connector.

6. Connect the PSCM 5−way connector. (Yellow cable).

NOTICE: Make sure connector is properly aligned to the connection at the PSCM prior to installation, this will help avoid damaging connector pins.

7. Remove the two PIM coolant plugs.

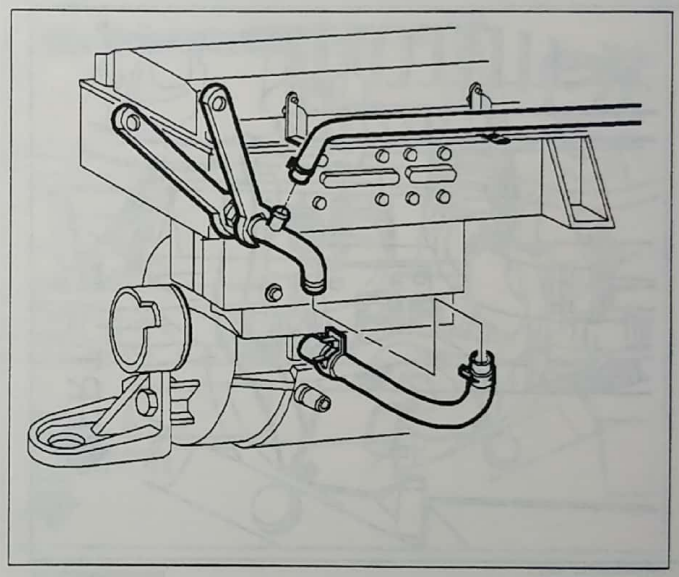


PSMPEN66278AA

8. Install cooling outlet hose to PIM.

Torque: 36 N•m (27 ft−lbs)

NOTICE: Always use a wrench to back up the opposing fitting when disconnecting connections. Failure to use a wrench to back up fittings could cause distortion of connections, fittings or components



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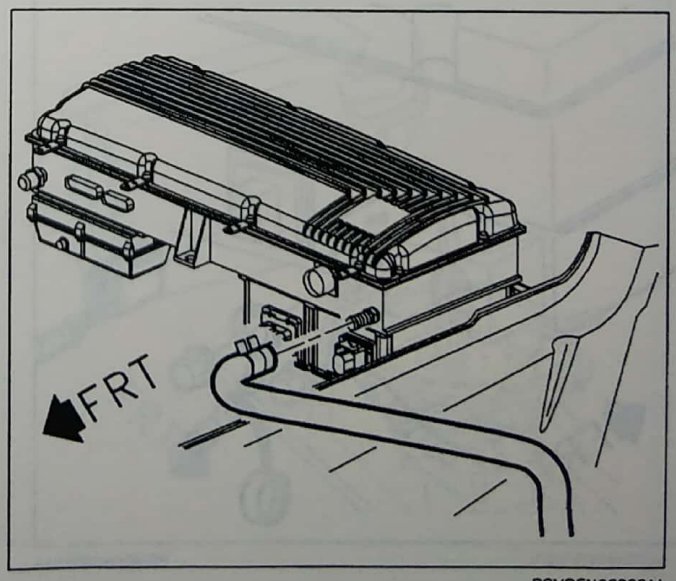
9. Install hose and clamp on PIM inlet cooling fitting. Position clamp tangs at 2 o'clock.



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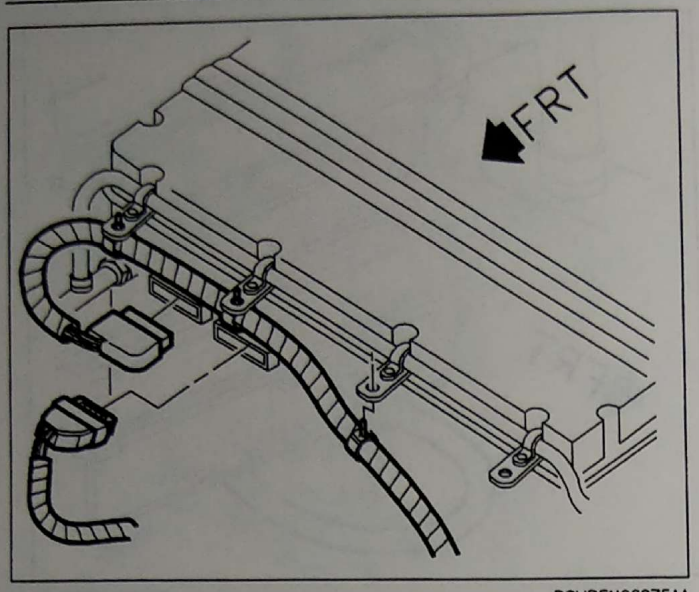
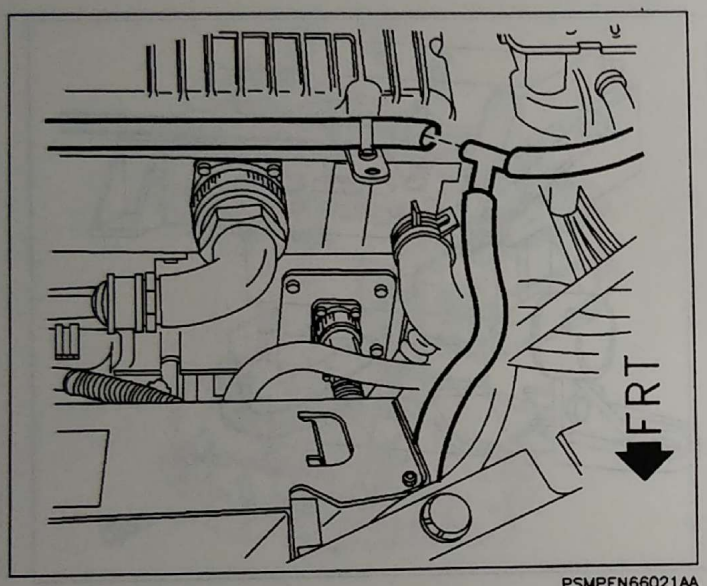


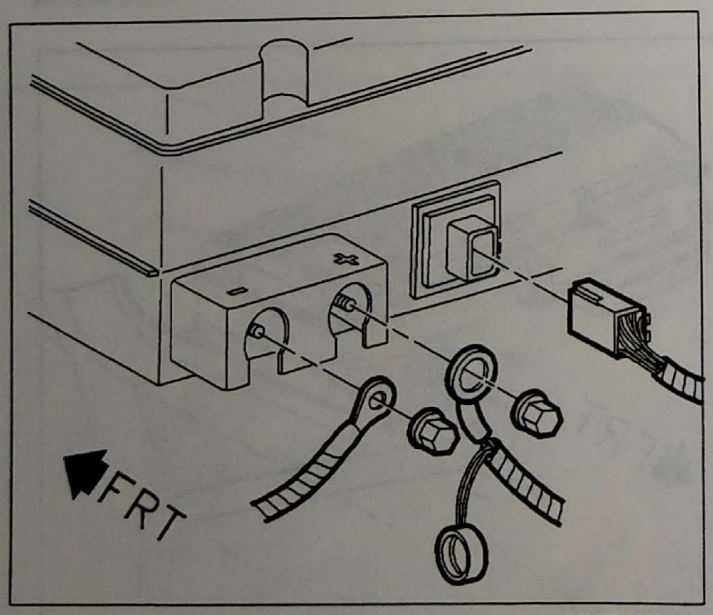
PSMPEN66075AA

10. Connect 32–way and the 24–way connectors at the front of the PIM.
11. Install the wire clips to retain PEB harness to the front PIM cover brackets.



PSMPEN66021AA

12. Install vent hose to vent "T."



PSMPEN66019AA

13. Connect the APM, 5–way connector at the rear of the APM.
14. Connect the negative and positive battery cables to the left rear of the APM.

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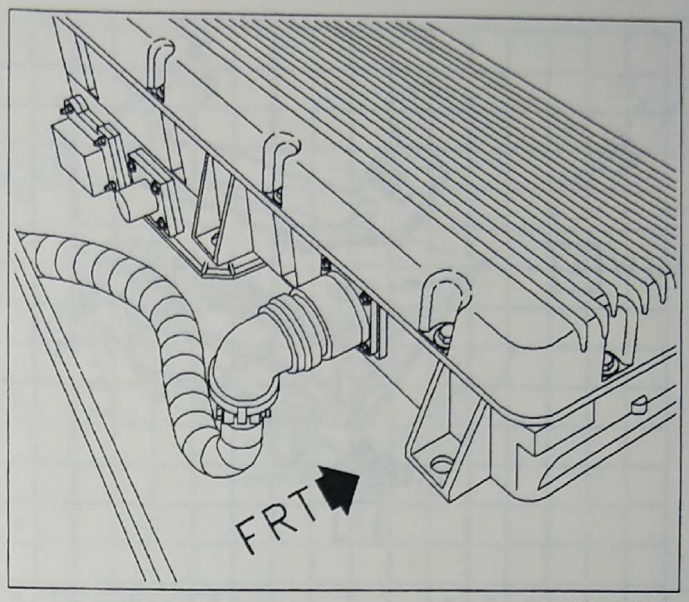
15. Connect battery assembly pack cannon connector to right rear corner of the PIM. Tighten connector until indicator marks line-up.

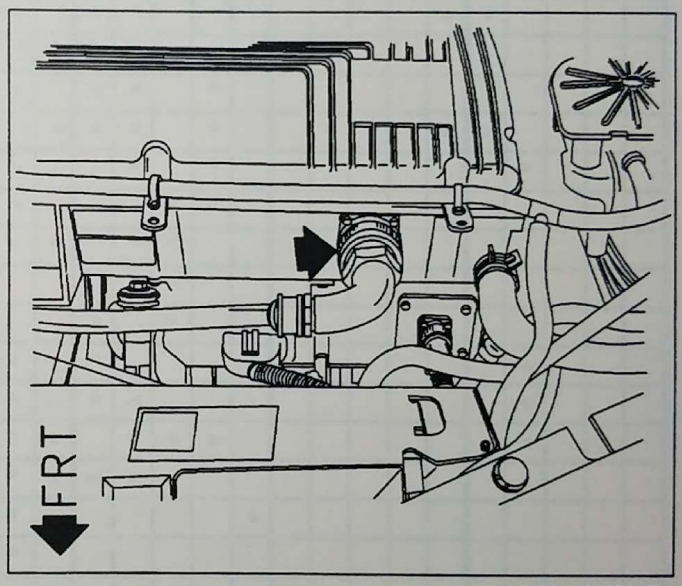
NOTICE: Do not use any tools to reinstall the connector. Excessive force or misalignment can damage the connector pins.



PSMPEN66279AA

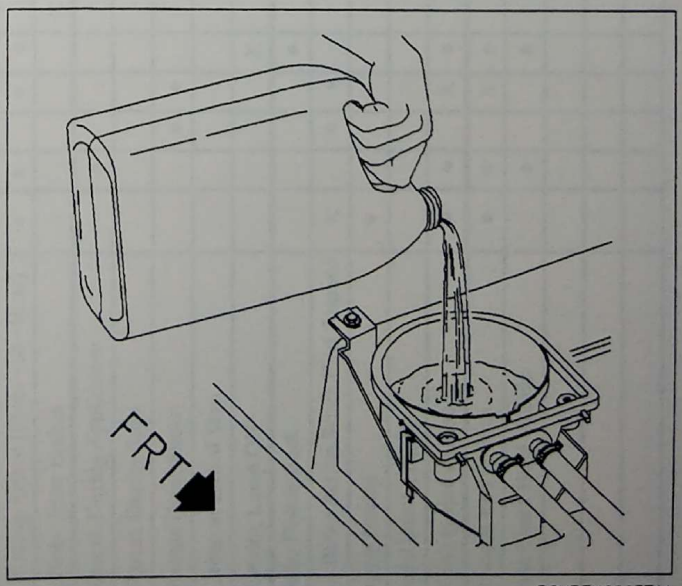
16. When service procedure is complete reinstall the charge receptacle to PIM connector.

NOTICE: Do not use any tools to reinstall the connector. Excessive force or misalignment can damage the connector pins.



PSMPEN65997AA

17. Check to insure that all the hoses and fittings are connected.
18. Fill coolant system until you reach the fill line on the expansion tank with GMEV coolant part 27002485 or equivalent which meets GM spec #9986100. The fluid level will drain down into the coolant system slowly and fluid should be added until the fluid level stabilizes.
19. Place vehicle in run mode. If vehicle does not power-up, refer to the "High Voltage" section of the service manual.
20. Maintain fluid level to fill line in expansion tank.
    a. After one minute turn on heat mode. Maintain fluid level to fill line in expansion tank.
    b. After one minute turn on vent mode.



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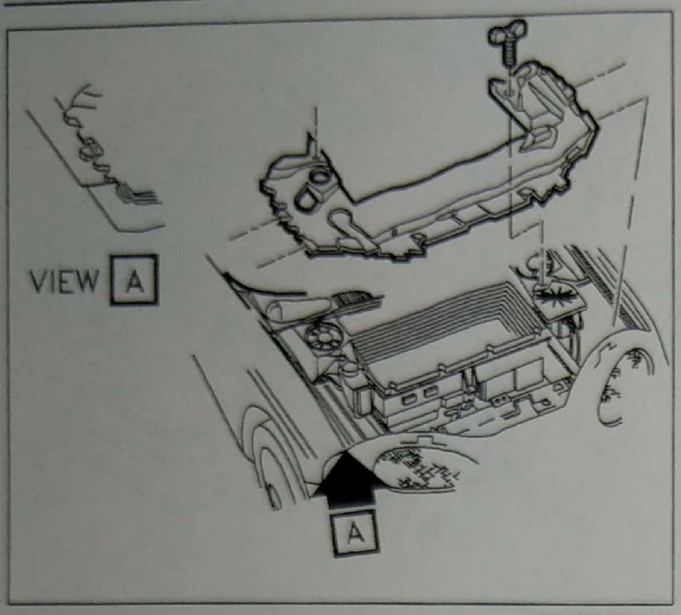

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21. Repeat previous step two more times.
22. After one minute turn on heat mode.
23. Insert charger paddle into charger receptacle. Verify charger is operating.
24. Maintain fluid level to fill line in expansion tank.
25. After one minute remove charger paddle from charger receptacle.
26. Turn HVAC system to vent mode.
27. Insert charger paddle into charger receptacle. Verify charger is operating.
28. After two minutes remove charger paddle from charger receptacle. Top off fluid level to fill line, install cover on expansion tank and check for leaks.
29. Install engine compartment sight shield.
30. Clear all codes using PDT.
31. Raise vehicle on hoist.
32. Install front underbody air deflector. (Refer to "Front Underbody Air Deflector Installation" procedure in this manual.)

X — Most Probable Cause(s)
• — Possible Causes
BRAKE CHART

COMPLAINT–CONDITION / CAUSE	Improper Pushrod/Bake Switch Dimension	Brake Pedal Linkage Interference/Binding	Brake Pedal Apply With Vehicle Off	Operator Riding Brake Pedal	Noisy Wheel Speed Sensor/Circuit	Internal Solenoid Leak	Leaky Pedal Feel Emulator	Sticky Pedal Feel Emulator	Low Brake Fluid Level	Leaking Brake Line or Connection	Leaking Front Caliper Piston Seal	Leaking Master Cylinder	Air In Brake System	Contaminated or Improper Brake Fluid	Worn Out Brake Lining	Glazed Brake Lining	Uneven Brake Lining Wear	Incorrect Lining Material	Contaminated Brake Lining	Excessive Brake Lining Dust	Heat Spotted/Scored Drums/Rotors	Out-Of-Round Rear Brake Drums	Excessive Rotor Thickness Variation	Excessive Rotor/Hub Lateral Runout	Faulty Automatic Adjusters	Weak or Incorrect Brake Shoe Springs	Brake ASM. Bolts Missing or Loose	Insufficient Brake Shoe Guide Lube/Shim	Restricted Fluid Passage	Sticking Front Caliper Piston	Caliper Not Sliding Freely	Rear Drum Tapered or Threaded	BTCM Fault	Improper PCM Interaction (Regen)	Noisy Pressure Sensor/Circuit	Faulty or Slow Rear Brake Assembly	Faulty or Slow Front Brake Pressure Modulator Valve
Excessive Brake Pedal Travel	•		•				•		•	•		•	X																				X				
Brake Pedal Travel Gradually Increases							X			X		X																									
Excessive Brake Pedal Effort		•		•					•							X				•													X	•	•	•	
Excessive Braking Action		•			•	•		•			•				X		•	•	X	X														•	•		
Brakes Slow to Respond		X											•	•		•																	X		•	•	
Brakes Slow to Release		•			•									•	•																		•				
Brakes Drag					•									•																			X				
Uneven Braking Action (Side–to–Side)		X			•									•		•	•	•	•	•	•																
Uneven Braking Action (Front–to–Rear)		•												•		•	•	•	•	•	•																
Scraping Noise from Brakes																	•	•	•	•		•															
Brakes Squeak During Application		•														•	•	•	•	•	•	•	•														
Brakes Squeak During Stop																		•	•	•	•	•	•	•													
Brakes Pulsate (Roughness)					•																	•	X	X	•												
Brakes Groan at End of Stop																					•	•	•														
Brake Warning Lamp ON													X																								
Brake Pedal Pushes Back													•																								
Excessive Brake Action When First Applied	X				•																																
Brake Apply Noises	•																																				
Sticky Pedal During Apply																																					
Brakes Grab at End of Stop	•				•								•																								
Brakes Fade at End of Stop	•				•								•																								
Park Brake Won't Hold Vehicle					•								•																								

DIAGNOSIS

BRAKE DIAGNOSTIC CHARTS

COMPLAINT/CONDITION	POSSIBLE CAUSE(S)	CORRECTION(S)
PEDAL FEEL		
Excessive Pedal Travel.	BTCM fault.	Check for DTCs.
	Brake pedal apply with vehicle off.	Advise operator.
	Leaky pedal feel emulator.	Replace brake pressure modulator valve assembly.
	Improper pushrod/brake switch dimension.	Check pushrod and brake switch, replace if necessary.
	Low brake fluid level.	Fill reservoir, check for leaks.
	Air in brake system.	Bleed brake system.
	Leak at brake line or hose connections.	Tighten connections. Replace line or hose.
	Internal master cylinder seal leak.	Replace master cylinder.
Vehicle Pulses While Braking.	BTCM fault.	Check for DTCs.
	Excessive brake system heat.	Check for brake drag.
	Rotor or rear drum out of specifications (e.g. lateral runout, parallelism, out of round, etc.).	Replace or refinish rotor. Replace rear drum.
	Worn out linings or linings wearing unevenly.	Replace linings.
	Wheel bearings worn.	Replace wheel bearing.
	Damaged suspension, knuckle or axle.	Inspect suspension components.

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COMPLAINT/CONDITION	POSSIBLE CAUSE(S)	CORRECTION(S)
Excessive Pedal Effort	BTCM fault.	Check for BTCM DTCs.
	Faulty or slow front/rear apply.	Check for DTCs. If necessary replace rear brake assembly or brake pressure modulator valve assembly.
	Noisy pressure sensor/circuit.	Check for DTCs. If necessary replace pressure sensor
	Improper PCM interaction. (Regen)	Check PCM DTCs.
	Caliper not sliding freely.	Inspect guide pins and bolts.
	Sticking front caliper piston.	Repair or replace caliper.
	Restricted fluid passage.	Check brake pipes, hoses, master, cylinder and brake pressure modulator valve assembly.
	Weak or incorrect brake shoe springs.	Replace springs.
	Excessive brake lining dust.	Remove dust.
	Incorrect lining material.	Replace linings.
	Low brake fluid level.	Fill reservoir, check for leaks.
	Excessive brake system heat.	Check for brake drag.
	Brake pedal linkage interference/ binding.	Inspect pedal linkage, replace if necessary.
	Worn or glazed linings.	Replace linings.
Squeal/Scrape While Not Braking.	Worn linings, sensor scraping on rotor (normal).	Replace linings.
	Loose rear drum brake components (spring, lever, adjuster, etc.)	Check rear drum brake components.
	Loose front suspension attachments.	Tighten attachments or replace.
	Caliper interference with rotor.	Check interference and repair.
	Bent or cracked suspension parts.	Replace components.
	Drum contacting backing plate.	Check clearance and repair.
	Lack of lubrication on rear brake assembly.	Lubricate.
Squeal/Scrape While Braking.	Worn linings, sensor scraping on rotor (normal).	Replace linings.
	Linings worn out, shoe contacting drum or rotor.	Replace linings.
	Lack of lubrication on backing plate or on adjuster screw.	Lubricate backing plate or adjuster screw.
	Lack of lubrication on caliper sliding surfaces.	Lubricate
	Lack of lubrication on brake pedal attachments.	Lubricate
	Damage to insulator between disc brake shoe and caliper piston.	Replace shoe and lining as needed.
	Hot spots or worn surface on drum or rotor.	Replace rotor or drum.
	Weak hold down springs or worn drum brake components.	Replace drum brake springs and or components as needed.
	Bent or distorted caliper shim.	Repair or replace linings/shim.

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COMPLAINT/CONDITION	POSSIBLE CAUSE(S)	CORRECTION(S)
NOISE		
Chatters/Rattles	Hot spots or worn surface on rear drum or front rotor.	Replace rear drum or rotor.
	Rotor or rear drum out of specifications (e.g. lateral runout, parallelism, out of round, etc.).	Replace rear drum. Refinish or replace rotor.
	Lining contaminated with foreign substances.	Replace linings.
	Linings wearing unevenly.	Replace linings.
	Bent or loose brake shoes.	Replace shoes and linings.
	Weak or broken retractor springs.	Replace rear drum brake springs.
	Loose brake lines.	Check brake line connections and tighten or replace as needed.
	Loose suspension components.	Inspect suspension components.
	Loose rear drum brake components (spring, lever, adjuster, etc.).	Check rear drum components.
Groans (at Near Stop)	Linings worn out.	Replace linings.
	Incorrect or damaged lining material.	Replace linings.
	Hot spots or worn surface on drum or rotor.	Replace drum or rotor.
	Cracked or bent knuckle or suspension parts.	Replace suspension component.
	Loose suspension.	Tighten suspension or replace.
Whine Noise During Decel	Regenerative braking.	Normal (Check in neutral).
Click/Clack During Brake Apply/Release	Brake pressure modulator valve assembly.	Normal, if excessive, check brake pressure modulator valve.
Brake Pull Left/Right	BTCM faults.	Check for DTCs.
	Front suspension out of alignment.	Align suspension.
	Restricted brake line or hose.	Replace line or hose.
	Faulty or slow brake pressure modulator valve assembly.	Check for DTCs, if necessary replace brake pressure modulator valve assembly.
	Caliper pistons sticking.	Replace caliper.
	Loose wheel bearings or suspension attachments.	Replace wheel bearings or tighten suspension attachments.
	Worn suspension components.	Replace suspension components.
	Loose steering or steering gear.	Repair or replace steering components.
	Uneven wear on tires, tires not properly inflated or incorrect tires for vehicle.	Check tires and replace if necessary. (Reset check tire pressure system).
	Uneven worn linings.	Replace linings.
	Air in system.	Bleed brake system.

COMPLAINT/CONDITION	POSSIBLE CAUSE(S)	CORRECTION(S)
PERFORMANCE		
Brakes Grab	BTCM fault.	Check for DTCs.
	Improper PCM interaction. (Regen)	Check for DTCs.
	Faulty or slow rear or front apply.	Check for DTCs. If necessary replace rear brake assembly or brake pressure modulator valve assembly.
	Noisy pressure sensor/circuit.	Check for DTCs. If necessary replace pressure sensor.
	Weak or incorrect brake shoe springs.	Replace Springs.
	Contaminated brake linings.	Replace linings.
	Damage to braking surface of rotors or drums.	Replace rotors or drums.
	Rotor or rear drum out of specifications (e.g. lateral runout, parallelism, out of round, etc.).	Replace rear drum or refinish/replace front rotor.
Brakes Drag	BTCM fault.	Check for DTCs.
	Improper pushrod/brake switch dimension.	Inspect pushrod and brake switch, replace if necessary.
	Faulty or slow rear brake assembly.	Check for DTCs. Replace rear brake assembly if necessary.
	Noisy pressure sensor/circuit.	Check for DTCs. Replace pressure sensor, if necessary.
	Operator riding brake pedal.	Advise operator.
	Bypass hole in master cylinder blocked.	Check pushrod and master cylinder interface, replace as necessary.
	Caliper piston stuck.	Replace caliper.
	Corroded caliper bolts. Caliper will not retract.	Replace guide pins and boots.
	Weak or incorrect drum brake return springs.	Replace rear drum brake springs.
	Contaminated or improper brake fluid, rubber seals are swollen.	Flush brake system and replace all rubber brake system components that come into contact with brake fluid, including hoses.
	Parking brake not releasing.	Check for DTCs.
	Self-adjusters over adjusting for lining wear.	Repair or replace adjusters, check linings.
	Sticking solenoid.	Check solenoid, replace if necessary.

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COMPLAINT/CONDITION	POSSIBLE CAUSE(S)	CORRECTION(S)
PERFORMANCE		
Brake Action Uneven (Front – Rear)	BTCM fault.	Check for DTCs.
	Faulty or slow front/rear apply.	Check for DTCs. If necessary replace rear brake assembly or brake pressure modulator valve assembly.
	Improper PCM interaction. (Regen)	Check for DTCs.
	Linings wearing unevenly front to rear.	Replace linings.
	Fluid leak in system.	Check system for leaks and repair or replace components.
	Hot spots or worn surface on drum or rotor.	Replace drum or rotor.
	Contaminated brake lining.	Replace linings.
	Noisy wheel speed sensor/circuit.	Check for DTCs. Replace wheel speed sensor if necessary.
	Uneven wear on tires, tires improperly inflated or incorrect tires installed.	Check tires and replace if needed. (Reset check tire pressure system.)
Brakes Slow to Release	BTCM fault.	Check for DTCs.
	Faulty or slow front/rear actuator.	Check for DTCs. Replace actuator if necessary.
	Caliper piston sticking.	Replace caliper.
	Improper PCM interaction. (Regen)	Check for DTCs.
	Corroded caliper bolts. Caliper will not retract.	Replace guide pins and boots.
	Contaminated or improper brake fluid, rubber seals are swollen.	Flush brake system and replace all brake system components that come into contact with brake fluid, including hoses.
	Worn caliper piston seals.	Replace caliper.
	Weak or incorrect rear drum brake return springs.	Replace rear drum brake springs.
	Worn or damaged master cylinder seals.	Replace master cylinder.
	Damage to mechanical action of brake pedal.	Check pedal and repair or replace.
	Noisy pressure sensor/circuit.	Check for DTCs. Replace pressure sensor if necessary.

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COMPLAINT/CONDITION	POSSIBLE CAUSE(S)	CORRECTION(S)
Slow Response/Excessive Stopping Distance	BTCM fault.	Check for DTCs.
	Faulty or slow front/rear apply.	Check for DTCs. If necessary replace rear brake assembly or brake pressure modulator valve assembly.
	Improper rotor surface finish.	Refinish or replace rotor.
	Linings not adjusting properly or damaged self-adjusters.	Adjust linings. If necessary replace adjuster.
	Caliper pistons sticking.	Replace caliper.
	Worn or glazed linings.	Replace linings.
	Incorrect lining material.	Replace linings.
	Lining contaminated with foreign substances.	Replace linings.
Odor	Linings over heated.	Refer to "Brakes Drag."
	Lining contaminated with foreign substances.	Replace linings.
	Incorrect lining material.	Replace linings.
	Operator riding brake.	Advise operator.
Brake Pedal Pushes Back	BTCM fault.	Check for DTCs.
	Internal solenoid leak.	Replace solenoid.
	Damage to mechanical action of brake pedal/master cylinder.	Check pedal and master cylinder repair or replace.
Sticky Pedal, During Apply	Sticky pedal feel emulator.	Replace brake pressure modulator valve assembly.
Red (Brake) Telltale On or Park Brake Telltale On or Flashing	BTCM fault.	Check for DTCs.

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COMPLAINT/CONDITION	POSSIBLE CAUSE(S)	CORRECTION(S)
PARKING BRAKE		
Does Not Hold	BTCM fault.	Check for DTCs.
	Faulty or slow rear brake assembly.	Replace rear brake assembly, if necessary.
	Linings worn out.	Replace linings.
	Linings contaminated with foreign material.	Replace linings.
	Incorrect lining material.	Replace linings.
	Weak or incorrect brake shoe springs.	Replace springs.
	Rear brake asm. Bolts missing or loose.	Replace or tighten bolts.
	Excessive brake lining dust.	Remove dust.
	Faulty automatic adjuster.	Replace rear brake assembly.
	Rear brake drum out of specifications.	Check rear brake drum. If necessary replace.
Does Not Release	BTCM fault.	Check for DTCs.
	Faulty rear brake assembly.	Check for DTCs. If necessary replace rear brake assembly.
	Dead auxiliary battery.	Check auxiliary battery.
	Vehicle not powered up.	Put vehicle in run mode, or apply brake pedal and check for power and release of park brake.

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DIAGNOSIS AND INSPECTION

BRAKE SYSTEM TESTING

Brakes should be tested on a dry, clean, reasonably smooth, and level roadway. A true test of brake performance cannot be made if roadway is wet, greasy, or covered with loose dirt, so that all tires do not grip the road equally. Testing will also be adversely affected if roadway is crowned so as to throw the weight of the vehicle towards wheels on one side or if roadway is so rough that wheels tend to bounce.

Test brakes at different vehicle speeds with both light and heavy pedal pressure; however, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency, since heavily braked but turning wheels will stop the vehicle in less distance than locked brakes. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

The EV1 uses an electrohydraulic front/rear electric brake system that is designed and balanced to avoid locking the wheels. It is designed this way because the shortest stopping distance and the best control is achieved without brake lock-up.

EXTERNAL CONDITIONS THAT AFFECT BRAKE PERFORMANCE

1. **Tires.** Tires having unequal contact and grip on the road will cause unequal braking. Tires must be equally inflated, identical in size, and the tread pattern of right and left tires must be approximately equal.
2. **Vehicle Loading.** When a vehicle has unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded vehicle requires more braking effort.
3. **Wheel Alignment.** Misalignment of the wheels, particularly in regard to excessive camber and caster, will cause the brakes to pull to one side.

BRAKE FLUID LEAKS

Depress the brake pedal and hold a constant foot pressure on the pedal. If the pedal gradually falls away with the constant pressure, the hydraulic system may be leaking. Perform a visual check to confirm any suspected leak.

Check the master cylinder fluid levels. While a slight drop in reservoir level does result from normal lining wear, an abnormally low level in the reservoir indicates an external leak in the hydraulic section of the brake system. The hydraulic section of the electrohydraulic brake system may be leaking either internally or externally.

FLUSHING BRAKE HYDRAULIC SYSTEM

Use only Delco Supreme 11, DOT 3 brake fluid P/N 12377967 (or equivalent) from a clean sealed container. It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic section of the brake system. Approximately 1000 ml or 34 ounces of fluid is required to flush the hydraulic section of the electrohydraulic brake system.

The system must be flushed if there is any doubt as to the grade of fluid in the system or if fluid has been used which contains the slightest trace of contamination. All rubber parts that have been subjected to a contaminated fluid must be replaced.

SUBSTANDARD OR CONTAMINATED BRAKE FLUID

Use only Delco Supreme 11, DOT 3 brake fluid P/N 12377967 (or equivalent) from a clean sealed container. Improper brake fluid, mineral oil, or water in the brake fluid may cause the brake fluid to boil or the rubber components in the hydraulic system to deteriorate. If primary piston cups are swollen, then rubber parts have deteriorated. This deterioration may also be evidenced by swollen master cylinder fluid reservoir cover diaphragm.

If deterioration of rubber is evident, disassemble all hydraulic parts and wash with alcohol. Dry these parts with compressed air before assembly to keep alcohol out of the brake system. Replace seals or master cylinder assembly as necessary. Replace all rubber parts in the system, including hoses. Also, when working on the brake mechanisms, check for fluid on the linings. If excessive fluid is found, replace the linings.

If the master cylinder piston seals are satisfactory, check for leakage or excessive heat conditions. If condition is not found, drain brake fluid, flush with brake fluid, refill, and bleed the brake system.

BRAKE HOSE INSPECTION

The hydraulic brake hoses should be inspected at least twice a year. The brake hose assembly should be checked for road hazard damage, cracks and chafing of the outer cover, and for leaks and blisters. Inspect for proper routing and mounting of the hose. A brake hose that rubs on suspension components will wear and eventually fail. If any of the above conditions are observed on the brake hose, adjust or replace the hose as necessary.

LINING INSPECTION

Inspect the brake linings every 10 000 km (6000 miles) and any time that the wheels are removed (tire rotation, etc.). Check both ends of the outer pad by looking in at each end of the caliper. These are the points at which the highest rate of wear normally occurs. However, at the same time, check the lining thickness on the inner pad/shoe to make sure that it has not worn prematurely. Look down through the inspection hole in the top of the caliper to view the inner pad. Whenever the thickness of any lining is worn to 1.0 mm (0.0394 in.) or less at either end of the pad/shoe, all disc brake pad/shoe and lining assemblies should be replaced at the same time.

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LINING REPLACEMENT

The Electric Vehicle (or equivalent) replacement brake lining material is recommended to maintain the balance between front and rear brake performance. Electric Vehicle replacement brake parts have been carefully selected to provide the proper brake balance for purposes of both stopping distance, controllability and wear over the full range of operating conditions. Installation of front or rear brake lining material with performance different from that of the Electric Vehicle replacement parts recommended for this vehicle can change the intended brake balance of this vehicle as well as damage rear brake drum surfaces.

When installing new front brake pads, remove all rust and corrosion from the caliper brackets and the spring clips. If installing used brake pads, remove all rust and corrosion from the ends of the brake pads and from the notch. Make sure the brake pads move freely in the caliper brackets when the brakes are assembled.

INFORMATION ON PERFORMING BRAKE SERVICE

Several important factors are frequently overlooked when performing brake service. The following list must be considered and followed when appropriate:

1. Proper machining of brake rotors is not a simple operation. Make sure the brake lathe is well maintained. Keep it clean at all times. Handle attachment hardware with care. Damaged hardware will not machine rotors accurately. Inspect closely the surface finish of machined rotors. Make sure the cutting tips remain in good condition. Use a dial indicator to make sure rotors turn squarely on the brake lathe.
2. Keep all installed brake parts as clean as possible. Make sure to clean machined brake rotors with a spray solvent (Saturn Choke Cleaner P/N 21007127 or Saturn Brake and Choke Cleaner P/N 21007432 or equivalent). Always wipe off machined brake rotor surfaces with a lint-free shop towel after cleaning.
3. **Thickness variation of rotors due to wear is a major cause of brake pulsation.** Using a micrometer, check for excessive thickness variation whenever a customer comments on brake pulsation.
4. Lateral rotor runout and restricted pads together are the leading cause of uneven brake rotor wear. Therefore, this combination leads directly to brake pulsation.

IMPORTANT: Make sure calipers slide freely on their pins. Make sure brake pads move freely in their brackets.

5. Uniform wheel nut torque is very important. Uneven torque can distort brake rotors, causing excessive lateral brake rotor runout. **A hand-held torque wrench** must be used to secure wheel nuts using a star tightening pattern, even when a torque stick and an air-powered impact gun are used.

Torque: 120 N•m (89 ft-lbs)

6. After rotors/drums and brake pads/shoes have been replaced, proper break-in promotes both longer life and quieter, smoother brake operation. To obtain proper brake-in, perform the following procedure.

BREAKING IN NEW BRAKE PADS AND NEW BRAKE SHOES.

Proper break-in of new brake pads and new brake shoes promotes both longer brake life and quieter, smoother brake operation. To obtain proper break-in, follow this procedure:

From 48 to 64 km/h (30 to 40 mph), shift into neutral and apply brakes gently until vehicle slows nearly to a stop. Accelerate vehicle back to 48 to 64 km/h (30 to 40 mph) and drive long enough for brakes to cool, about 30 to 40 seconds. Repeat this process five times, each time allowing sufficient time between stops for brakes to cool.

Complete the break-in procedure by shifting the vehicle into neutral and gently slowing the vehicle from 89 to 32 km/h (55 to 20 mph) four times. Allow 30 to 40 seconds between stops for brakes to cool. This break-in procedure will reduce brake noise and increase brake life and performance.

INSPECTING AND REFINISHING BRAKE ROTORS

In manufacturing the brake rotor, tolerances of the braking surfaces for flatness, parallelism, and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness and brake noise.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the braking surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

When performing routine brake maintenance **DO NOT** refinish rotor assemblies. Refinish a rotor assembly **ONLY** under the following circumstances.

- There is brake pulsation caused by the rotors.
- Rotors are excessively scored. (Scoring of the rotor surfaces not exceeding 1.5 mm [0.060 in.] in depth, which may result from normal use, is not detrimental to brake operation.)

THICKNESS VARIATION CHECK

Thickness variation can be checked by measuring the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.

A rotor that varies in thickness by more than 0.013 mm (0.0005 in.) can cause front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

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LATERAL RUNOUT CHECK

1. Remove road wheel and install two wheel nuts to retain rotor.

NOTICE: Do not torque wheel nuts over 10 N•m (89 in–lbs) during this procedure.

2. Fasten a dial indicator to the steering knuckle so that the indictor stylus contacts the rotor about 10 mm (0.40 in.) from the rotor edge.
3. Zero the dial indicator.
4. Rotate the rotor two complete revolutions and observe total indicated runout (TIR). Dial should return to zero.

Maximum Lateral Runout:	0.060 mm (0.0024 in.)

Lateral runout of the rotor, if excessive, can often be improved by cleaning dirt and rust from hub and rotor mating surfaces and/or indexing the rotor on the hub one or two bolt positions from the original position. If the lateral runout cannot be corrected by indexing the rotor, check the hub and bearing assembly for excessive lateral runout. If the hub and bearing assembly lateral runout exceeds 0.038 mm (0.0015 in.), replace the hub and bearing assembly. If lateral hub and bearing runout is within specifications, refinish or replace the rotor as necessary.

REPLACING BRAKE ROTORS

WHEN INSTALLING NEW BRAKE ROTORS, DO NOT REFINISH THE SURFACES AS THESE PARTS ARE AT THE CORRECT LEVEL OF SURFACE FINISH.

REFINISHING BRAKE ROTORS

Accurate control of the rotor tolerances is necessary for proper performance of the disc brakes. Machining of the rotor should be done only with precision equipment.

All brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that does not meet the specifications as listed in the specifications.

If rotors are removed, remove rust and scale from the rotor/hub and rotor/wheel mating surfaces. Failure to do so can cause excessive lateral runout when the rotor is mounted on the brake lathe or when the rotor is installed to the hub.

WHEN REFINISHING ROTORS, ALWAYS USE SHARP CUTTING INSERTS (BITS, TIPS). DULL OR WORN INSERTS LEAVE A POOR SURFACE FINISH WHICH WILL AFFECT BRAKING PERFORMANCE.

Make sure the brake lathe is clean and free of debris before turning rotors. Remove metal filings from the mating surface between the lathe and the cutting assembly. Remove filings from behind the tool bit holders.

Some brake lathes (Accu-turn™ or equivalent) can refinish a rotor's surface with one cut, regardless of the depth. **HOWEVER, THE ROTOR MUST NOT VIBRATE DURING THE REFINISHING OPERATION.** Use the vibration dampening devices provided with the lathe.

Manufacturers of brake lathes that cannot control rotor vibration during deep cuts recommend several cuts to achieve the desired finish. Following the instructions provided with the lathe will help ensure high-quality machining.

Regardless of the brake lathe used, a shallow finish cut will not yield the best surface finish. A shallow cut of 0.051 mm (0.002 in.) "smears" the rotor's surface, creating a rougher-than-desired finish. Cutting at least 0.127 mm (0.005 in.) (per side) will leave a smoother surface, resulting in better brake performance.

MAKE SURE TO USE THE PROPER CUTTING INSERTS. USE THE CUTTING INSERTS RECOMMENDED BY THE BRAKE LATHE'S MANUFACTURER. Check the cutting inserts' condition regularly. Replace them at the first sign of inferior refinishing. **FOLLOWING ALL THE LATHE'S MACHINING INSTRUCTIONS WILL FACILITATE ACQUIRING THE DESIRED SURFACE FINISH.**

All brake lathes use a single-point cutting tool. **THIS TOOL WILL NOT YIELD THE NECESSARY SURFACE FINISH. A SECONDARY FINISHING OPERATION MUST BE PERFORMED.** To obtain the necessary finish, follow this procedure: With the rotor turning in the brake lathe, sand each side of the rotor for a minimum of 90 seconds with 150 grit sand paper mounted on a sanding block. Use moderate pressure. After sanding, clean the rotor **THOROUGHLY**. Use Saturn Brake Cleaner P/N 21007432 (or equivalent).

THE SURFACE FINISH QUALITY OF A MACHINED ROTOR SHOULD BE AS HIGH AS A NEW ROTOR. FAILURE TO OBTAIN THIS BEST POSSIBLE ROTOR SURFACE FINISH WILL NEGATIVELY AFFECT BRAKING PERFORMANCE.

ROTORS SHOULD ALWAYS BE REPLACED IF MACHINING RESULTS IN A ROTOR THAT DOES NOT MEET THE MANUFACTURER'S SPECIFICATIONS FOR MINIMUM ROTOR THICKNESS.

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RECOMMENDED PROCEDURE FOR MACHINING BRAKE ROTORS

A brake rotor is a precision machined part. It must be properly machined to provide proper service.

1. All rust and corrosion must be removed from the mounting surfaces of the rotor. Use a wire brush or a wire wheel and a drill to remove all corrosion and scale from the mounting surfaces of the rotor.
2. Make sure the correct "bell clamps" are used to mount the brake rotor on the brake lathe. Some bell clamps may appear to fit flush inside the brake rotor, but actually they may be too large, forcing the brake rotor to "wobble" when it turns on the lathe. (Bell clamp outside diameter ("D") must be less than 139 mm [5.47 in.]). If a brake rotor does not turn on a plane that is parallel to the brake lathe's cutting tip, lateral runout will be machined into the brake rotor.
3. Both surfaces of the inside bell clamp must be parallel or the rotor will not turn on a parallel plane with the cutting tip. If a bell clamp is dropped or damaged in any way, contact the brake lathe's manufacturer to obtain a new bell clamp.
4. Use the largest possible "spacers" to hold the bell clamps on the lathe's spindle. This makes sure that there is the most mass possible on the spindle, helping the rotor to turn on a parallel plane with the brake lathe's cutting tip.
5. Use a magnetic dial indicator to make sure that the rotor turns squarely on the brake lathe. Attach the dial indicator on the lathe and check rotor runout. Mark the highest point of lateral runout on the rotor. Loosen the attachment hardware and rotate the rotor 180 degrees while holding the inside bell clamp in its original position. Tighten attachment hardware and recheck rotor runout. Any runout must follow the rotor. The marked high spot must remain the high spot. If not, some problem exists in the attachment of the rotor on the lathe, such as bent bell clamps, incorrect bell clamps, or untrue mounting surfaces.
6. Visually check the machined rotor's surface finish. Any deterioration in surface finish quality usually indicates worn cutting tips. Always use the cutting tips recommended by the brake lathe's manufacturer.
7. A secondary finishing operation improves rotor surface finish. Some brake lathe manufacturers offer lathe-mounted tools for this purpose. If no such tool is available, Saturn recommends using silicon carbide 150 grit emery paper mounted on a sanding block. Using moderate pressure, hold paper against the rotor as it turns in the lathe for 90 seconds per side.
8. Thoroughly clean machined rotors with a spray solvent such as Saturn Choke and Brake Cleaner (or equivalent).

INSPECTING REAR BRAKE DRUMS

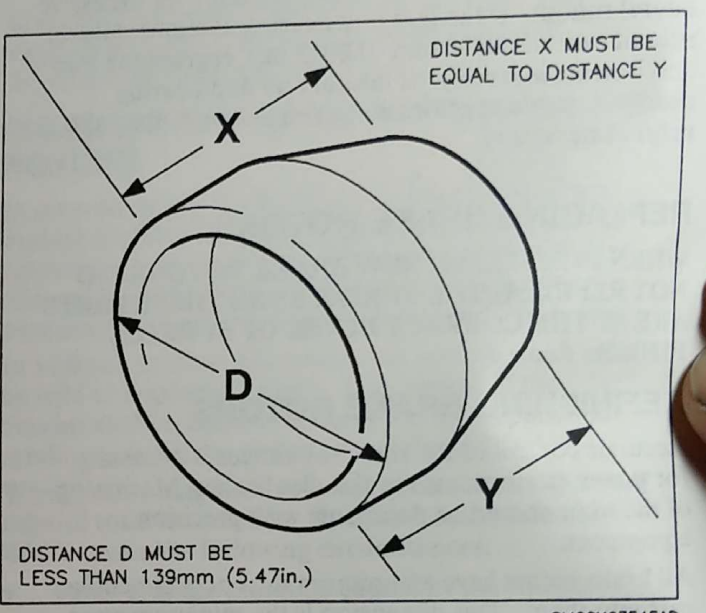
Whenever rear brake drums are removed, they should be thoroughly cleaned and inspected for any defects, cracks, severe scoring and roundness.

CRACKED OR SEVERELY SCORED REAR DRUMS

A cracked rear brake drum must be replaced. Do not attempt to weld or repair a cracked drum.

The EV1 uses a Metal Matrix Composite (MMC) rear brake drum. Some moderate to heavy scoring of the drum surface is typical and is not detrimental to brake operation. **SCORED APPEARANCE IS TYPICAL, DO NOT REFINISH/TURN.**

Moderate to heavy scoring of rear brake drum surface is NOT unusual. Unless brake performance is negatively affected and/or noise, pulsation or roughness is experienced DO NOT REPLACE DRUMS. If linings have worn to the point of metal to metal contact with the drum, replace both linings and drum. Linings can be replaced without replacing drums. Scoring of rear brake drum surface is typical.



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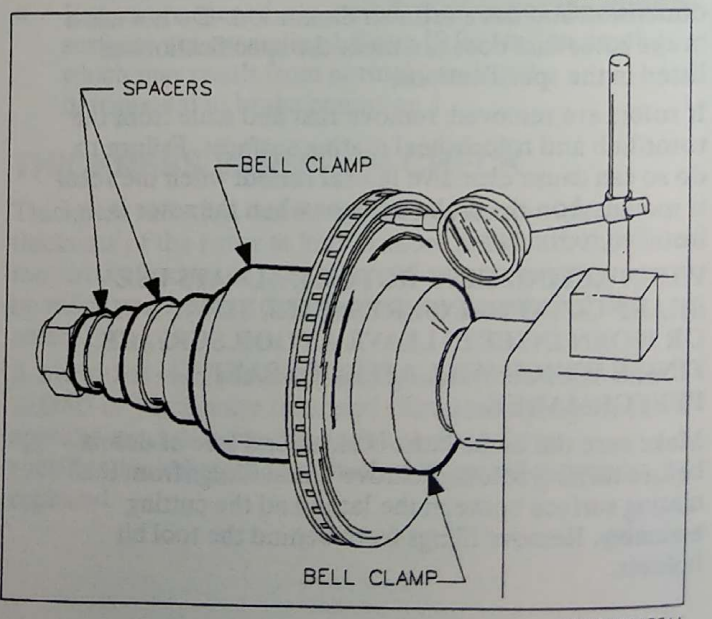

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RADIAL-ROUND OUT

An out-of-round rear brake drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanisms due to its eccentric action. When the drum exceeds the radial round out specification limits 0.15 mm (0.006 in), the drum should be replaced.

NOTICE: The metal matrix composite (MMC) rear brake drums used on the EV1 are not compatible with brake drum refinishing/turning machines and may cause damage to the equipment and or operator. The metal matrix composite (MMC) rear brake drum is serviced by replacement only.

NOTICE: When installing new metal matrix composite (MMC) rear brake drums, do not refinish/turn. These parts should be at the correct level of surface finish and runout.

IMPORTANT: Electric Vehicle (or equivalent) replacement brake lining material is recommended for this vehicle to maintain the balance between the front and rear brake performance. Electric Vehicle (or equivalent) replacement brake parts have been carefully selected to provide the proper brake balance for the purpose of stopping distance and control over the full range of operating conditions. Installation of front or rear brake lining material with performance characteristics different from the recommended Electric Vehicle (or equivalent) replacement parts can change the intended brake balance for this vehicle.

BRAKE DRUM AND HUB RADIAL RUNOUT CHECK - ON VEHICLE

1. Release park brake.
   a. Place keypad in **LOCK** mode.
   b. Depress brake pedal.
   c. While brake pedal is depressed, push park brake apply/release button.

NOTICE: Parking brake must be OFF for removal of brake drum(s). Brake drum(s) cannot be remove with the parking brake set.

2. Raise vehicle on hoist. (Refer to "Lifting, Jacking and Support Points" in this manual.)

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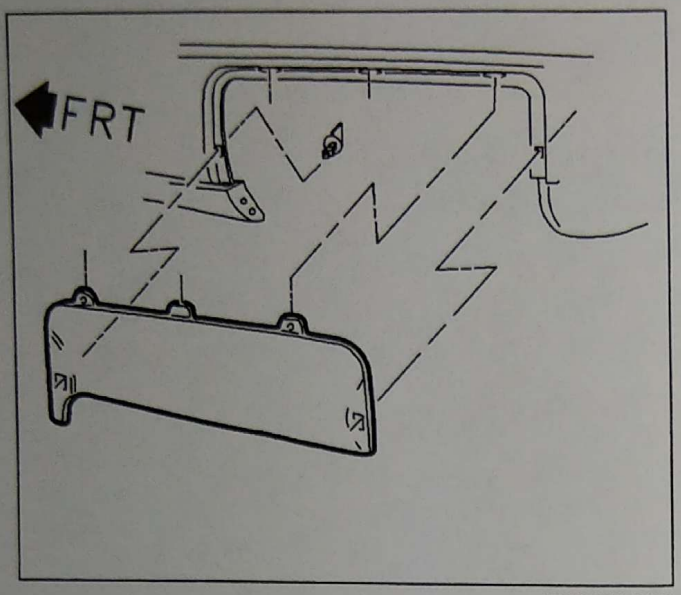

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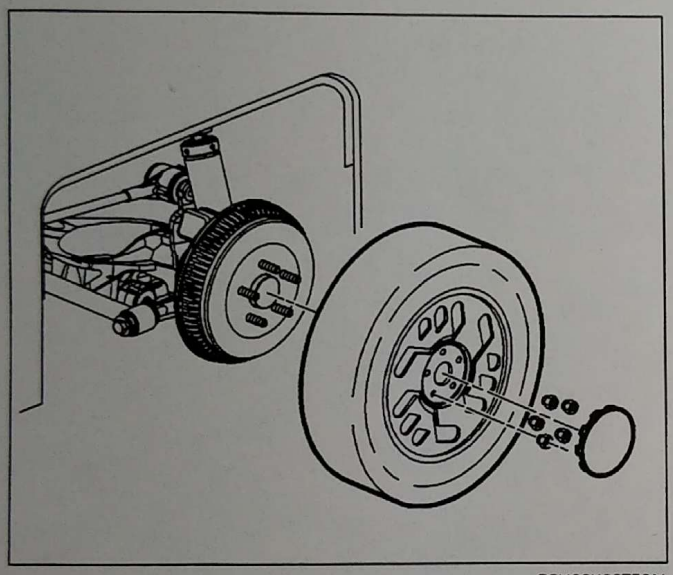

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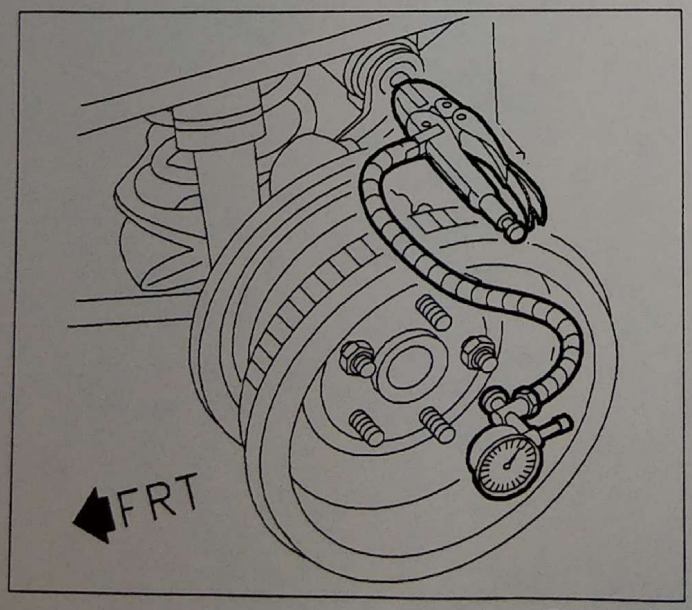

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3. Remove rear wheel opening cover(s).
4. Remove road wheel.
5. Remove brake drum and install on hub backwards. Secure drum with two wheel nuts also installed backwards (flat side toward drum).
6. Fasten a dial indicator with a flex shaft base to the rear suspension upper link or other fixed object, that will allow the dial indicator tip to reach the drum shoe surface on the inside of the drum.
7. Position dial indicator tip against brake drum shoe surface.
8. Rotate the drum to the lowest reading.
9. Zero the dial indicator.
10. Rotate the drum two complete revolutions and observe total indicated runout (TIR).
    a. If the combined brake drum and hub radial runout does not exceed 0.28 mm (0.011 in.), proceed to step 11.
    b. If the combined drum and hub radial runout exceeds 0.28 mm (0.011 in.), proceed to step 17.

Maximum TIR (combined brake drum and hub): 0.28 mm (0.011 in.)

11. Move dial indicator neck to allow removal of the brake drum. It is not necessary to remove dial indicator base from its attachment point.
12. Remove brake drum from hub and turn 180 degrees and again, install on hub backward. Secure brake drum with two wheel nuts also installed backwards (flat side toward brake drum).
13. Position dial indicator tip against brake drum shoe surface.
14. Rotate the brake drum to the lowest reading.
15. Zero the dial indicator.
16. Rotate the brake drum one complete revolution and observe total indicated runout (TIR).

Maximum TIR (combined brake drum and hub): 0.28 mm (0.011 in.)

    a. If the combined brake drum and hub radial runout does not exceed 0.28 mm (0.011 in.), brake drum and hub are within specification and no repair is required.
    b. If the combined brake drum and hub radial runout exceeds 0.28 mm (0.011 in.), proceed to step 17.

17. Remove brake drum and install on a brake lathe using a tapered cone to properly center drum.
18. Fasten a dial indicator to the lathe
19. Position dial indicator tip against brake drum shoe surface.
20. Rotate brake drum to lowest reading.
21. Zero the dial indicator.

22. Rotate the brake drum one complete revolution and observe total indicated runout.

Maximum TIR (brake drum): 0.15 mm (0.006 in.)

If the brake drum radial runout exceeds 0.15 mm (0.006 in.), replace the brake drum.

23. Subtract total indicated runout (TIR) measurement obtained in step 22 (brake drum runout) from TIR measurement obtained in step 10 (combined brake drum and hub runout). The difference between these two readings represents hub runout.

Combined Drum and Hub Runout - Drum Runout = Total Hub Runout

If the hub runout exceeds 0.13 mm (0.005 in.), replace the hub and bearing assembly.

NOTICE: The metal matrix composite (MMC) rear brake drum is serviced by replacement only. Do not attempt to refinish/turn.

OFF-CAR DRUM RADIAL RUNOUT CHECK

1. Release park brake.
   a. Place keypad in **LOCK** mode.
   b. Depress brake pedal.
   c. While brake pedal is depressed, push park brake apply/release button.

NOTICE: Parking brake must be OFF for removal of brake drum(s). Brake drum(s) cannot be remove with the parking brake set.

2. Raise vehicle on hoist. (Refer to "Lifting, Jacking and Support Points" in this manual.)

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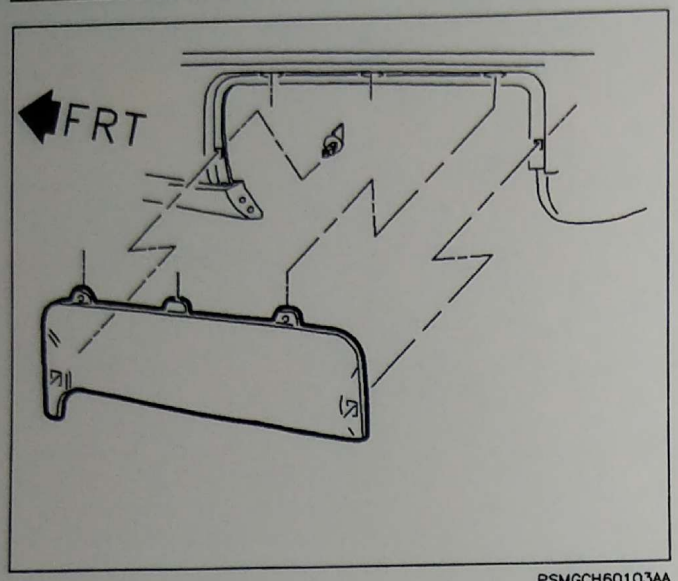

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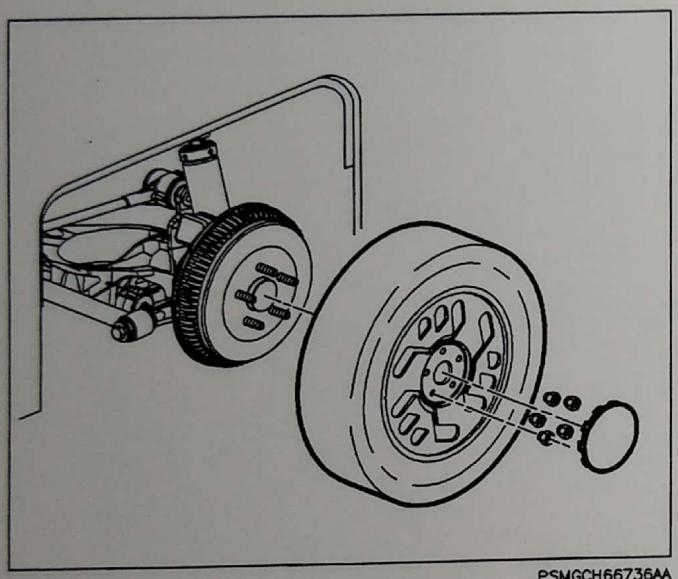

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3. Remove rear wheel opening cover(s).
4. Remove road wheel
5. Remove rear brake drum and install on brake lathe using a tapered cone to properly center drum.
6. Fasten a dial indicator to the lathe.
7. Position dial indicator tip against drum shoe surface.
8. Rotate the drum to the lowest reading.
9. Zero the dial indicator.
10. Rotate the brake drum one complete revolution and observe total indicated runout (TIR).

    Maximum Radial Runout (drum): 0.15 mm (0.006 in.)

If the brake drum radial runout exceeds 0.15 mm (0.006 in.), replace the brake drum.

NOTICE: The metal matrix composite (MMC) rear brake drum is serviced by replacement only. Do not attempt to refinish/turn.

VISUAL/PHYSICAL UNDERHOOD INSPECTION

A careful visual and physical inspection must be performed as part of any diagnostic procedure or in finding the cause of a failure. This can often lead to fixing a problem without further steps. Inspect all hoses for correct routing, pinches, cuts, leaking, or disconnects. Inspect all the wires in the motor compartment and to the wheel speed sensors for proper connections, burned or chafed spots, pinched wires, or contact with sharp edges. This visual/physical inspection is very important. It must be done carefully and thoroughly.

KNOWLEDGE AND TOOLS REQUIRED

To use this manual most effectively, a general understanding of basic electrical circuits and circuit testing tools is required. One should be familiar with wiring diagrams, the meaning of voltage, ohms, amps, the basic theories of electricity as well as hydraulics, and understanding what happens in an open or shorted circuit.

To perform system diagnosis, the use of diagnostic scan tool is required. A test lamp, ohmmeter, digital voltmeter with 10 megohms impedance and jumper wires are also required as well as line wrenches and bleeding equipment. Please become acquainted with the tools and their use before attempting to diagnose a vehicle.

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DIAGNOSTICS

The brake torque control module (BTCM) stores diagnostic information that, when accessed with a Scan tool or other diagnostic equipment, will provide detailed diagnostic information if a fault occurs. There are a total of 92 codes that are provided to assist with BTCM system diagnosis. Diagnostics will also reveal whether or not a fault is intermittent. With the BTCM diagnostic system, fault codes can only be read and cleared with a Scan tool or other diagnostic equipment. However, if no faults occur for 100 drive cycles, fault codes are cleared from the BTCM. A BTCM drive cycle occurs if the BTCM is awake (vehicle is in run or brake pedal is pressed) and the vehicle is driven faster than 16 km/h (10 mph).

DIAGNOSTIC INFORMATION

The diagnostic trouble tree charts and functional checks in this manual are designed to locate a faulty circuit or component through logic based on the process of elimination. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are no multiple failures. Trouble tree charts are designed to be used only when a code is present.

The brake torque control module (BTCM) performs a continual self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures used in this manual. The language for communicating the source of a malfunction is a system of diagnostic trouble codes. The codes are three digit numbers that can range from 011 to 168. When a malfunction is detected by the BTCM control module a code is set and one or more telltales are illuminated.

AMBER ANTILOCK TELLTALE

As a bulb and system check, the telltale will come on when the the keypad is placed in run mode, and turn off after about three seconds. If the lamp remains on, the self diagnostic system has detected a problem. The lamp will remain on until vehicle run has been cycled Off. When turn is cycled back On the BTCM runs the self-diagnostic test to see if the problem is still present. If the problem remains, the light will stay On, informing the driver that an antilock brake system problem has occurred and that the ABS system has been disabled. The vehicle should be taken for service as soon as possible.

RED BRAKE TELLTALE

As a bulb and system check, the telltale will come on when the keypad is placed in run mode, and turn off after about three seconds. If the lamp remains on, the self diagnostic system has detected a problem. The lamp will remain on until vehicle run has been cycled Off. When run mode is cycled back On the BTCM runs the self diagnostic test to see if the problem is still present. If the problem remains, the light will stay On, informing the driver that a base brake problem has occurred and that the vehicle should be towed to the service facility.

RED PARK BRAKE TELLTALE

The PARK BRAKE Light will illuminate when the park brake is applied. It will flash during a park brake apply or release, then go out. If there is a park brake failure the light will continue to flash, informing the driver that an park brake system problem has occurred. The vehicle should be taken for service as soon as possible.

SERVICE SOON TELLTALE

The BTCM will cause the SERVICE SOON light to illuminate if a telltale failure (DTC 11) or regen fault (DTCs' 141, 167, or 168) is detected. The vehicle should be taken for service as soon as possible.

READING DIAGNOSTIC TROUBLE CODES

The provision for communicating with the BTCM is the data link connector (DLC). The DLC is located under the instrument panel, to the left of the steering column. The DLC is used to communicate with the seven EV1 on board controllers. The codes stored in the BTCM can be read ONLY from the DLC with a Scan tool or other diagnostic equipment. When a fault is detected, telltale(s) are lit, and code(s) are placed in the General Information table (current codes). When the vehicle is powered off, the current code(s) are moved to the Malf history table (past codes) and cleared from the General Information table.

CLEARING DIAGNOSTIC TROUBLE CODES

Current diagnostic trouble codes (DTCs) will be cleared when the vehicle is cycled off. Past DTCs (Malf History) will be cleared after 100 drive cycles with no fault occurring. Both types of DTCs will be cleared when the clear codes selection is selected on the scan tool or other diagnostic equipment.

IMPORTANT: Disconnecting power to the BTCM has no effect on DTCs stored in Malf history, but it will clear DTCs in general information.

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DATA LINK CONNECTOR (DLC) SCAN TOOLS

The EV1's seven on board controllers communicate a variety of information through the data link connector (DLC). This data requires a Scan tool or other diagnostic equipment for interpretation.

With an understanding of the data which the tool displays, and knowledge of the circuits involved, the tool can be very useful in obtaining information that would be more difficult or impossible to obtain with other equipment. Scan tools do not make the use of diagnostic charts unnecessary, nor can they indicate exactly where a problem is in a particular circuit. Diagnostic trouble charts incorporate diagnosis procedures using a Scan tool where possible, and most charts require the use of a Scan tool when it is applicable.

SCAN TOOL USAGE WITH INTERMITTENTS

In some Scan tool applications, the data update rate makes the tool less effective than a voltmeter, as when trying to detect an intermittent problem which lasts for a very short time. However, the Scan tool does allow one to manipulate wiring harness or components while observing the readout of the Scan tool.

The Scan tool can be plugged in and observed while driving the vehicle under the condition when the telltale lamp turns on. If the problem seems to be related to certain parameters they should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the Scan tool should checked on each position, watching for a period of time to see if there is any change in the readings that would indicate intermittent operation.

The Scan tool is also an easy way to compare the operating parameters of a known good system with a malfunctioning system.

The BTCM has the ability to take a snapshot of data when a code is set. This information will be stored for up to three codes, and can be found with a Scan tool listed under Malf history. This information can be very useful when attempting to troubleshoot intermittent codes or flags.

The Scan tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the Scan tool successfully for good diagnosis lies in the technicians ability to understand the system being diagnosed, as well as an understanding of the Scan tool's operation and limitations. The technician should read the tool manufacturer's operating manual to become familiar with the tool's operation.

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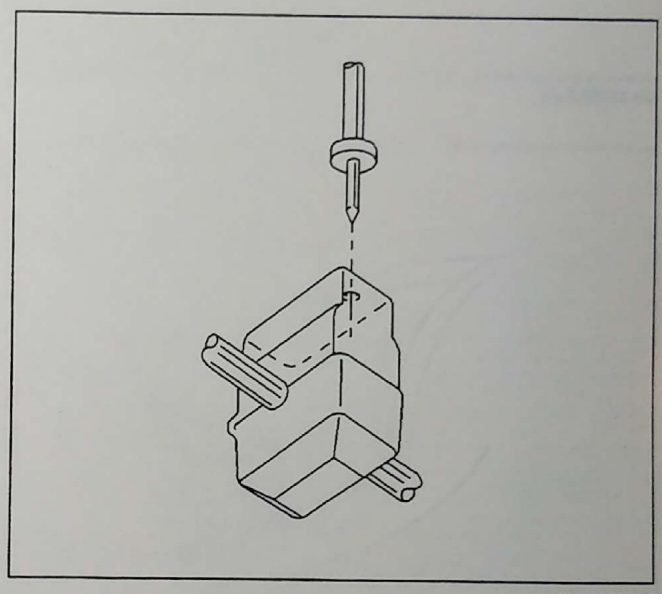
DIAGNOSTICS USING THE DIAGNOSTIC SERVICE PROBE

DIAGNOSTIC SERVICE PROBE

IMPORTANT: Diagnostic service probes are for use on .35, .50 and .80 mm (22, 20 and 18 gage) wires only.

IMPORTANT: The diagnostic service probes must be left on the wire after use. The probe contains a sealant that will protect the wire from corrosion. Do not remove the diagnostic service probe after use.

The use of the diagnostic service probe offers many advantages in system diagnostics over the old *jumper wire* and *terminal back-probe* methods. The most important advantage of the diagnostic service probe method of diagnostics is the ability to observe the operation of a circuit without disturbing the components or connections. This is an important advantage since many circuit failures are vibration or connection related. The diagnostic service probe is designed to firmly hold multimeter test probes to allow more accurate readings while the circuit is operating. Circuits with bad connectors, grounds or components are easier to diagnose while they are operating.



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Attach the diagnostic service probe to the wire leading to the connector and insert your multimeter into the diagnostic service probe. Put the meter on the appropriate scale and observe the readings. If the readings do not compare with the expected readings, gently wiggle the wire back and forth in the connector. If the reading on the meter changes while you are wiggling the wire, the terminal or connector are faulty. Disconnect the connector and examine the terminals and connector cavities for damage. Check the terminals to see if a known good terminal makes a firm connection. Do this by inserting a known good male terminal into the female terminal you are testing. The male terminal should be held firmly in place by the female terminal and should not be loose enough to fall out if the female terminal is held downward. Likewise, test a male terminal by inserting it into a known good female terminal. The two terminals should fit snugly together and should not separate if the male terminal is held vertically downward.

If the connections are good (both wire connections and the connection to the component), check the ground connection. Attach a diagnostic service probe to the ground side of the circuit or component. Place a multimeter probe in the diagnostic service probe and the other probe to a known good ground.

IMPORTANT: Check the accuracy of the multimeter first by touching the leads together. The meter should read less than 0.10 ohm with the leads touching.

Place the multimeter on the lowest ohmmeter scale. The meter should read less than one ohm. If the meter reads more than one ohm, check the connections to the

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ground attachment point. Attach a jumper wire from the ground attachment point. Attach the other end of the jumper wire to a known good ground and watch the multimeter to see if the reading goes below one ohm. If the reading goes below one ohm, remove the ground screw or nut, clean the connection surfaces and install. If the reading stays above one ohm, check for an open in the ground wire. Also check for continuity from the component to the diagnostic service probe.

Other uses for the diagnostic service probe:

- Compare voltage readings across connectors, components, or lengths of wire. This allows you to observe the operation of a circuit without the addition of jumper wires or back-probing connections. The best time to diagnose most circuits is while they are operating.
- Observe changing voltages and compare them to what the BTCM is reporting. This can be done by comparing the voltage readings of the BTCM inputs to the reported BTCM readings displayed on the portable diagnostic tool (PDT) or the service stall system (SSS). This can help detect damaged or faulty BTCM connections, or a faulty BTCM.

IMPORTANT: There are differences between the actual voltages from the sensors and the reported voltages by the BTCM. This is due to the internal conversion of these voltages to binary data by the BTCM. However, the voltages should generally vary together and the difference should be less than 0.2 volt.

- The diagnostic service probe can be used with future test equipment to gain access to a circuit for testing or calibration.
- The diagnostic service probe can be used to give a good ground access point. Attach a diagnostic service probe to a ground circuit and insert the multimeter lead in the probe at a ground reference. Check the ground circuit to verify the ground path is good.

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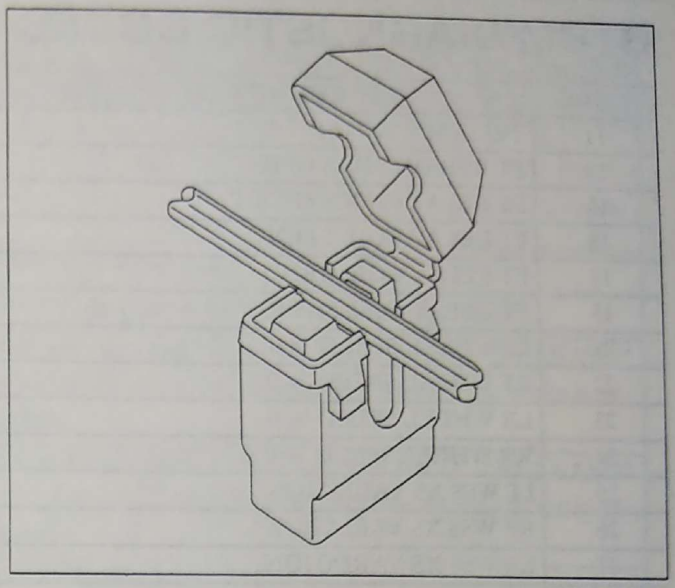
INSTALLATION

1. Place the cable into the V-slot of the terminal.
2. Press the cable into the V-slot by hand and initiate closing the cover.



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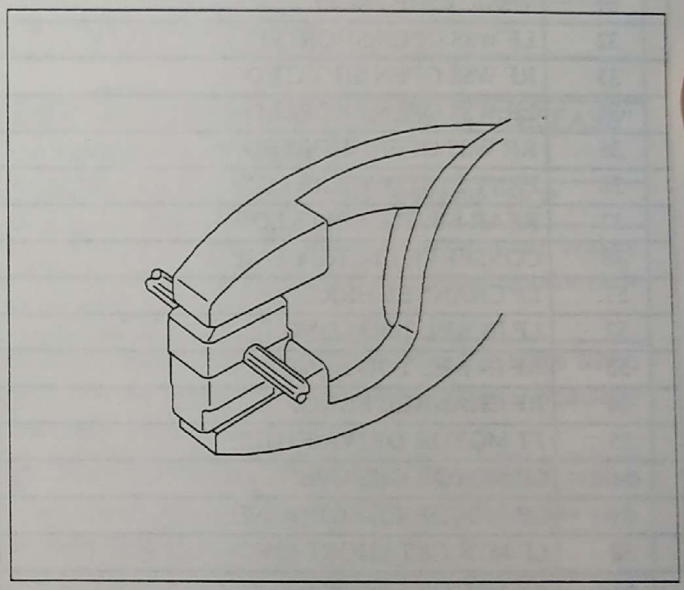
3. Close the cover completely by pressing the cable into the diagnostic service probe terminal with pliers until the cover locks shut. A snap should be felt or heard when the cover locks.
4. To probe the wire, insert the multimeter probe into the housing through the gel to contact the terminal. The housing has a thin wall of material to pierce with the multimeter probe. In some locations the multimeter probe should be used to pierce the probe opening, before the probe is installed on the wire.

IMPORTANT: Once the probe is installed, it should not be removed. The diagnostic service probes were designed to stay on the wires permanently. The gel material inside the probe will seal the wire and allow the wire to be probed several times.



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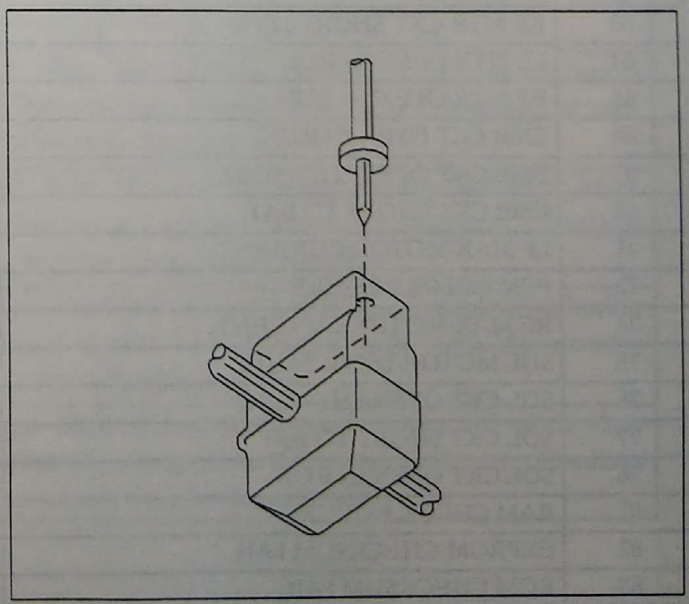

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BTCM DIAGNOSTIC CODES

CODE	DESCRIPTION	CODE	DESCRIPTION
11	TELLTALE FAILED	86	RUNNING RESET FAILED
14	FT RELAY CNTCS OPEN	87	LOOP TIME OVERRUN
15	FT RELAY CNTCS SHORT	91	BRAKE SWITCH OPEN
16	FT RELAY COIL OPEN	94	BRAKE SWITCH CLOSED
17	FT RELAY COIL GRND	95	BRAKE SW CKT OPEN
18	FT RELAY COIL SHORT	96	BRAKE LIGHT CKT OPEN
21	LF WHEEL SPEED = 0	114	RR RELAY CNTCS OPEN
22	RF WHEEL SPEED = 0	115	RR RELAY CNTCS SHORT
23	LR WHEEL SPEED = 0	116	RR RELAY COIL OPEN
24	RR WHEEL SPEED = 0	117	RR RELAY COIL GRND
25	LF WSS XS VARIATION	118	RR RELAY COIL SHORT
26	RF WSS XS VARIATION	121	MCPS 1 GROUND/OPEN
27	LR WSS XS VARIATION	122	MCPS 1 SHORT 12V
28	RR WSS XS VARIATION	123	MCPS 2 GROUND/OPEN
31	WSSIC CHIP FAULT	124	MCPS 2 SHORT 12V
32	LF WSS OPEN/SHORTED	125	LFPS GROUND/OPEN
33	RF WSS OPEN/SHORTED	126	LFPS SHORT 12V
34	LR WSS OPEN/SHORTED	127	RFPS GROUND/OPEN
35	RR WSS OPEN/SHORTED	128	RFPS SHORT 12V
36	FRNT SYSTM VOLTS LOW	131	LFPS SKEWED
37	REAR SYSTM VOLTS LOW	132	RFPS SKEWED
38	CONSERVE ENERGY FAIL	133	LR PARK BRAKE FAILED
51	LF CHANNEL ERROR	134	RR PARK BRAKE FAILED
52	LF IN REL TOO LONG	135	REAR MDI FAULT 1
53	RF IN REL TOO LONG	136	REAR MDI FAULT 2
54	RF CHANNEL ERROR	137	REAR MDI FAULT 3
55	FT MOTOR DRIVR FAULT	138	REAR MDI FAULT 4
56	LF MOTOR CKT OPEN	141	REGEN COMM FAULT
57	LR MOTOR CKT GROUND	142	PARK LATCH FAILED
58	LF MTR CKT SHORT 12V	143	PRES DIF TOO LARGE
61	RF MOTOR CKT OPEN	144	LR HIGH DRAG
62	RF MOTOR CKT GROUND	145	RR HIGH DRAG
63	RF MTR CKT SHORT 12V	147	LR FREE SPINS
64	LF MTR OPEN IN RUN	148	RR FREE SPINS
65	RF MTR OPEN IN RUN	152	REAR RLEASE TOO LONG
66	EMB CKT OPEN IN RUN	153	LRM CKT OPEN IN RUN
67	EMB CKT OPEN/SHT–GND	154	RRM CKT OPEN IN RUN
68	EMB CKT SHORT TO BAT	155	REAR MTR DRIVER FAIL
71	LF MAX MOTOR CURRENT	156	LRM CKT OPEN
72	PCM COMM FAILURE	157	LRM CKT GROUNDED
74	RF MAX MOTOR CURRENT	158	LRM CKT SHORT TO 12V
75	SOL MOTOR DRVR FAULT	161	RRM CKT OPEN
76	SOL CKT OPEN/SHT–GRD	162	RRM CKT GROUNDED
77	SOL CKT SHORT TO BAT	163	RRM CKT SHORT TO 12V
78	SOL CKT OPEN IN RUN	164	PARK MOTOR CKT OPEN
81	RAM CHECK FAILURE	165	PARK MOTOR GROUNDED
82	EEPROM CHECKSUM FAIL	166	PARK MTR SHORT 12V
83	ROM CHECKSUM FAIL	167	RTD ACHVD MATCH FAIL
84	PARK SWITCH FAILURE	168	RGN ACHVD DC SKEWED

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BTCM SCAN TOOL INFORMATION		
GENERAL INFO		
LF WHEEL SPD MPH	0–80 Miles Per Hour	Left front wheel speed.
LR WHEEL SPD MPH	0–80 Miles Per Hour	Right front wheel speed.
RF WHEEL SPD MPH	0–80 Miles Per Hour	Left rear wheel speed.
RR WHEEL SPD MPH	0–80 Miles Per Hour	Right rear wheel speed.
VEHICLE REF MPH	0–80 Miles Per Hour	Filtered average of all four wheel speed sensors.
RR MOTOR	"RELEASE" or "APPLY"	Indicates direction of brake motor travel. "RELEASE" when motor in home position, or after parking brake is engaged.
LR MOTOR	"RELEASE" or "APPLY"	Indicates direction of brake motor travel. "RELEASE" when motor in home position, or after parking brake is engaged.
SOLENOID	"ON" or "OFF"	"On" when braking.
RF MOTOR	"RELEASE" or "APPLY"	Indicates direction of brake motor travel. "RELEASE" when motor in home position.
LF MOTOR	"RELEASE" or "APPLY"	
PARK MOTOR	"RELEASE" or "APPLY"	"APPLY" when parking brake is activated, "RELEASE" when parking brake is released.
DISABLE ABS/TCS	"YES" or "NO"	"YES" when ABS/TCS is disabled, normally "NO"
LF SENSED AMP	0.0 – 20.0 amps	Left Front Motor sensed current; 0.0 amps when brakes are not applied, 20.0 amps maximum. Readings are variable when braking is active.
LF COMMAND AMP	0.0 – 20.0 amps	Left Front Motor commanded current; 0.0 amps when brakes are not applied, 20.0 amps maximum. Readings are variable when braking is active.
RF SENSED AMP	0.0 – 20.0 amps	Right Front Motor sensed current; 0.0 amps when brakes are not applied, 20.0 amps maximum. Readings are variable when braking is active.
RF COMMAND AMP	0.0 – 20.0 amps	Right Front Motor commanded current; 0.0 amps when brakes are not applied, 20.0 amps maximum. Readings are variable when braking is active.
LR SENSED AMP	0.0 – 12.0 amps	Left Rear Motor sensed current; 0.0 amps when brakes are not applied, 12.0 amps maximum. Readings are variable when braking is active.
LR COMMAND AMP	0.0 – 12.0 amps	Left Rear Motor commanded current; 0.0 amps when brakes are not applied, 12.0 amps maximum. Readings are variable when braking is active.
RR SENSED AMP	0.0 – 12.0 amps	Right Rear Motor sensed current; 0.0 amps when brakes are not applied, 12.0 amps maximum. Readings are variable when braking is active.
RR COMMAND AMP	0.0 – 12.0 amps	Right Rear Motor commanded current; 0.0 amps when brakes are not applied, 12.0 amps maximum. Readings are variable when braking is active.

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BTCM SCAN TOOL INFORMATION		
GENERAL INFO		
SOL SENSED AMP	0.0 –3.5 amps	Brake Solenoid sensed current; 0.0 amps when not braking, approximately 1.0 amps when brakes applied (solenoids active).
SOL COMMAND AMP	0.0 –3.5 amps	Brake Solenoid commanded current; 0.0 amps when not braking, approximately 1.0 amps when brakes applied (solenoids active).
EMB SENSED AMP	0.0 – 10.0 amps	Electro–Magnetic Brake sensed current; 0.0 amps when not braking, approximately 3.5 – 4.0 amps when brakes applied, unless energy conserve mode active, then 0.0 amps.
EMB COMMAND AMP	0.0 – 10.0 amps	Electro–Magnetic Brake commanded current; 0.0 amps when not braking, approximately 3.5 – 4.0 amps when brakes applied, unless energy conserve mode active, then 0.0 amps.
P BRAKE WAKEUP V	0.0 – 12.0 volts	Parking Brake Switch Wake Up voltage. 0.0 volts indicates switch not activated, approximately 9.5 volts indicates switch active.
P BRAKE IDLE V	0.0 – 5.0 volts	Parking Brake Switch Idle voltage. 0.0 volts indicates switch not activated, 5.0 volts indicates switch active.
MCPS1 SENSE VLT	0.0 – 5.0 volts	Approximately 0.5 volts when brakes are not applied, 5.0 volts maximum. Readings are variable when braking is active.
MCPS2 SENSE VLT	0.0 – 5.0 volts	Approximately 0.5 volts when brakes are not applied, 5.0 volts maximum. Readings are variable when braking is active.
LFPS SENSE VLT	0.0 – 5.0 volts	Approximately 0.5 volts when brakes are not applied, 5.0 volts maximum. Readings are variable when braking is active.
RFPS SENSE VLT	0.0 – 5.0 volts	Approximately 0.5 volts when brakes are not applied, 5.0 volts maximum. Readings are variable when braking is active.
ABS ACTIVE	"YES" or "NO"	Normally "NO". "YES" when the ABS system is active.
LO TRACTION TT	"ON" or "OFF"	Normally "OFF". "ON" when telltale is commanded on by the BTCM because low traction conditions have been detected.
BRAKE REQUEST	"YES" or "NO"	"YES" when service brake is applied.
BRAKE TT	"ON" or "OFF"	Normally "OFF". "ON" when telltale is commanded on by the BTCM because a fault has been detected.
BRAKE SW CKT	"OPEN" or "CLOSED"	Normally "CLOSED". "OPEN" when the BTCM detects an open circuit.
BRAKE SWITCH	"ON" or "OFF"	Normally "OFF". "ON" when the service brake is applied.
F ENABLE RELAY V	0–17.12	Sensed voltage at the contact side of the Front Enable "Relay" located in the LHJB. Normally battery voltage (13.5 or 14.5 volts) in Run or if brakes are applied.

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BTCM SCAN TOOL INFORMATION		
GENERAL INFO		
R ENABLE RELAY V	0–17.12	Sensed voltage at the contact side of the Rear Enable "Relay" located in the LHJB. Normally battery voltage (13.5 or 14.5 volts) in Run mode or if brakes are applied.
RUN 1 VOLTS	0–17.12	Normally battery voltage (13.5 or 14.5 volts) in Run mode.
R ENABLE RELAY	"ON" or "OFF"	"ON" when the Front Enable "Relay" is commanded on by the BTCM.
F ENABLE RELAY	"ON" or "OFF"	"ON" when the Rear Enable "Relay" is commanded on by the BTCM.
UPDATE FAILED	"YES" or "NO"	Normally "NO". A DTC will be present if "YES" is displayed.
10 MPH REACHED	"YES" or "NO"	"YES" if the vehicle has reached 10 mph this Run cycle.
PK BRK TT FLASH	"YES" or "NO"	"YES" if parking brake is active (engaging or disengaging).
PARK BRAKE TT	"ON" or "OFF"	"ON" when parking brake is engaged.
ABS FAIL TT	"ON" or "OFF"	Normally "OFF". "ON" when the telltale is commanded on by the BTCM because a fault has been detected.
PK BRAKE LATCHED	"YES" or "NO"	"YES" when parking brake is engaged. Parking brake engages automatically when shifted into park.
LF REHOME DONE	"YES" or "NO"	"YES" if rehome has been performed this Run cycle.
RF REHOME DONE	"YES" or "NO"	"YES" if rehome has been performed this Run cycle.
REAR REHOME DONE	"YES" or "NO"	"YES" if rehome has been performed this Run cycle.
PK BRAKE SWITCH	"YES" or "NO"	"YES" if switch is active.
PK BRAKE ENABLE	"YES" or "NO"	
PK BRAKE REQUEST	"YES" or "NO"	"YES" if parke brake has been requested.
REHOME OCCURED	"YES" or "NO"	"YES" if rehome has been performed this Run cycle.
CURRENT CODES		
T–CODE/FLAG	"YES" or "NO"	"YES" if any current DTC's are present.
HISTORY CODES		
T–CODE/FLAG	"YES" OR "NO"	"YES" if any history DTC's are present.
# 1 FAULT DTC	XXX	Diagnostic Trouble Code number of the first fault detected.
# 2 FAULT DTC	XXX	Diagnostic Trouble Code number of the second fault detected..
# 3 FAULT DTC	XXX	Diagnostic Trouble Code number of the third fault detected..
FLT 1 # OF OCCUR	XXX	Number of occurrences of fault number 1.
FLT 2 # OF OCCUR	XXX	Number of occurrences of fault number 2.
FLT 3 # OF OCCUR	XXX	Number of occurrences of fault number 3.
CYC FLT 1 1ST SET	XXX	Number of Run cycles since fault 1 first occured.
CYC FLT 2 1ST SET	XXX	Number of Run cycles since fault 2 first occured.
CYC FLT 3 1ST SET	XXX	Number of Run cycles since fault 3 first occured.
CYC FLT 1 LAST SET	XXX	Number of Run cycles since fault 1 last occured.

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BTCM SCAN TOOL INFORMATION		
HISTORY CODES		
CYC FLT 2 LAST SET	XXX	Number of Run cycles since fault 2 last occured.
CYC FLT 3 LAST SET	XXX	Number of Run cycles since fault 3 last occured.
LAST FAULT SET	XXX	Diagnostic Trouble Code number of the most recent fault detected..
ABS FAIL TT	"ON" or "OFF"	Status at the time the last fault was set.
ABS ACTIVE	"YES" or "NO"	Status at the time the last fault was set.
TCS ACTIVE	"YES" or "NO"	Status at the time the last fault was set.
BRAKE REQUEST	"YES" or "NO"	Status at the time the last fault was set.
BRAKE TT	"ON" or "OFF"	Status at the time the last fault was set.
BRAKE SW CKT	"OPEN" or "CLOSED"	Status at the time the last fault was set.
BRAKE SWITCH	"ON" or "OFF"	Status at the time the last fault was set.
REF VELOCITY MPH	0–80 Miles Per Hour	Filtered average of all four wheel speed sensors at the time the last fault was set.
BRAKE CMD V	0–17.2	
FRONT RELAY V	0–17.2	Sensed voltage at the contact side of the Front Enable "Relay" at the time the last fault was set.
RAER RELAY V	0–17.2	Sensed voltage at the contact side of the Rear Enable "Relay" at the time the last fault was set.
# CYC SIN LAST	XXX	Number of Run cycles since the most recently detected fault was active.
REGEN / TRACTION INF		
PCM RTD REQ NM	XXXX	Amount of retard (Regen) in Newton Meters requested form the PCM. Variable while braking.
REGEN DISABLE	"YES" or "NO"	Normally "NO". "YES" if a fault is present that requires Regen to be disabled.
REGEN ACH MATCH	"YES" or "NO"	
PULSE OVERFLOW	"YES" or "NO"	Normally "NO". "YES" if a fault is present in the BTCM.
REGEN ACH DATA	"YES" or "NO"	Normally toggles between "YES" and "NO" as new data is received.
REGEN COM PRES	"YES" or "NO"	Normally "YES". "NO" if no regen information is being communicated with the PCM.
REGEN FAIL FLAG	"YES" or "NO"	Normally "NO". "YES" if the BTCM has detected a possible Regen fault.
REGEN MATCH TEST	"YES" or "NO"	Normally "NO". "YES" if the BTCM performing a correlation test.
REG PWM FAIL	"YES" or "NO"	
PCM RTD ACH NM	XXXX	The amount of Regen achieved by the PCM, in Newton Meters. Variable while braking.
ABS FAIL TT	"ON" or "OFF"	Normally "OFF". "ON" when the telltale is commanded on by the BTCM because a fault has been detected.
ABS ACTIVE	"YES" or "NO"	Normally "NO". "YES" when the ABS system is active.

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BTCM SCAN TOOL INFORMATION		
REGEN / TRACTION INF		
TCS ACTIVE	"YES" or "NO"	Normally "NO". "YES" when the BTCM has detected low traction conditions.
BRAKE REQUEST	"YES" or "NO"	"YES" when service brake is applied.
BRAKE TT	"ON" or "OFF"	Normally "OFF". "ON" when telltale is commanded on by the BTCM because a fault has been detected.
BRAKE SW CKT	"OPEN" or "CLOSED"	Normally "CLOSED". "OPEN" when the BTCM detects an open circuit.
BRAKE SWITCH	"ON" or "OFF"	Normally "OFF". "ON" when the service brake is applied.
LR VARIATION	0.0–1.0	Left Rear variation gain. This value will change to allow compensation for slightly unequal braking force between the left and right wheels.
RR VARIATION	0.0–1.0	Right Rear variation gain. This value will change to allow compensation for slightly unequal braking force between the left and right wheels.
STATUS INFO		
ABS FAIL TT	"ON" or "OFF"	Normally "OFF". "ON" when the telltale is commanded on by the BTCM because a fault has been detected.
ABS ACTIVE	"YES" or "NO"	Normally "NO". "YES" when the ABS system is active.
TCS ACTIVE	"YES" or "NO"	Normally "NO". "YES" when the BTCM has detected low traction conditions.
BRAKE REQUEST	"YES" or "NO"	"YES" when service brake is applied.
BRAKE TT	"ON" or "OFF"	Normally "OFF". "ON" when telltale is commanded on by the BTCM because a fault has been detected.
BRAKE SW CKT	"OPEN" or "CLOSED"	Normally "CLOSED". "OPEN" when the BTCM detects an open circuit.
BRAKE SWITCH	"ON" or "OFF"	Normally "OFF". "ON" when the service brake is applied.
SYSTEM ID		
ECU ID	XXXX	
DATE CODE	XXXXX	
SEQ NO.	XXXXXX	
CAL ID	XX	
ABSG ID	XXXXX	

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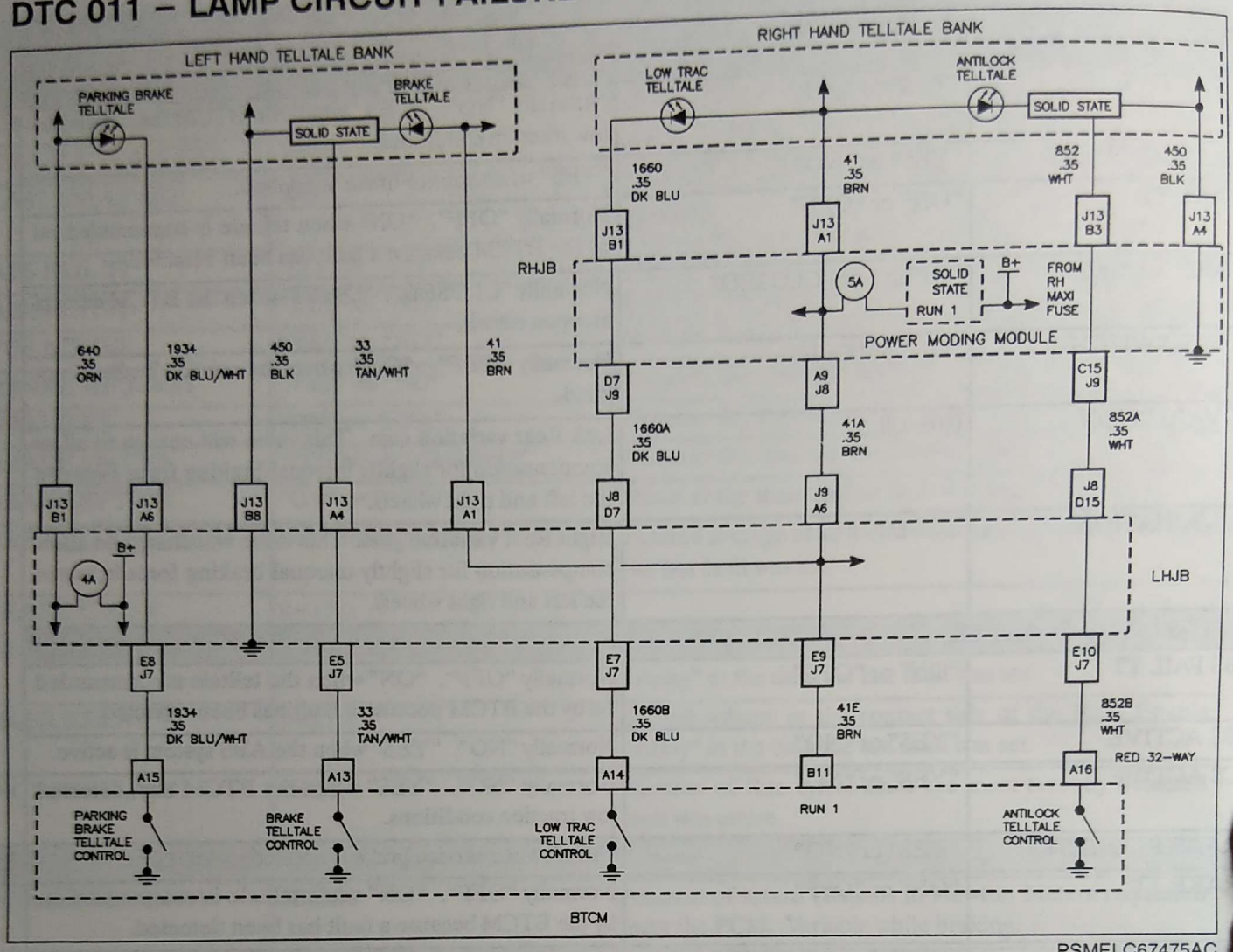
DTC 011 – LAMP CIRCUIT FAILURE



PSMELC67475AC

LAMP CIRCUIT FAILURE

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

DTC 11 will set if:
An open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK lamps turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 011
LAMP CIRCUIT FAILURE

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

Is more than one telltale inoperative?

Yes → Refer to "Telltales" charts in the "Electrical" Service Manual.

No

PARKING BRAKE telltale stays On	Chart A
PARKING BRAKE telltale inoperative	Chart B
BRAKE telltale stays On	Chart C
BRAKE telltale inoperative	Chart D
LOW TRAC telltale stays On	Chart E
LOW TRAC telltale inop	Chart F
ANTILOCK telltale stays On	Chart G
ANTILOCK telltale inoperative	Chart H

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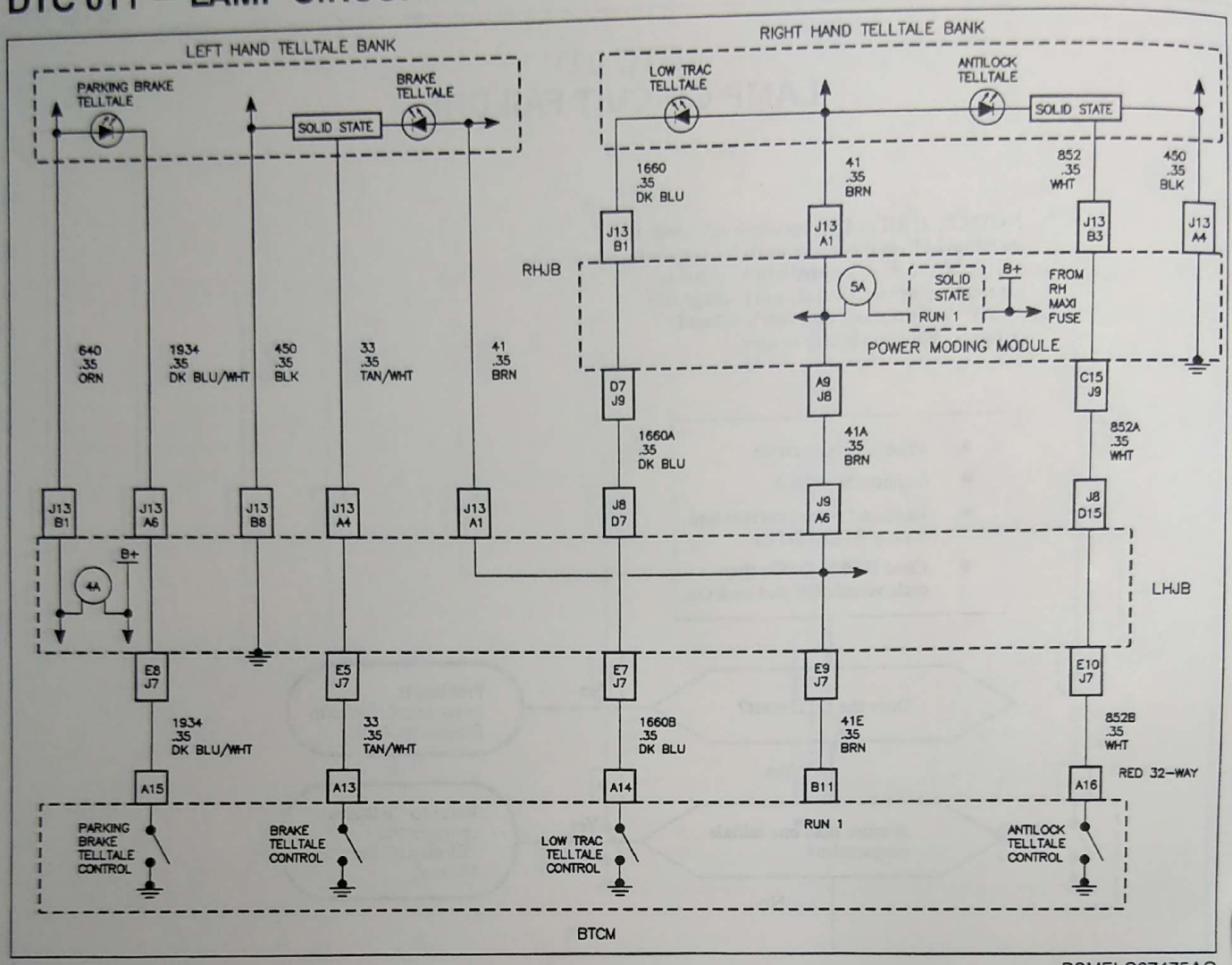
DTC 011 – LAMP CIRCUIT FAILURE



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LAMP CIRCUIT FAILURE – CHART A

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

DTC 11 will set if:
An open, short-to-ground, or short-to-battery is detected in the brake system antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 011
PARKING BRAKE TELLTALE STAYS ON
CHART A

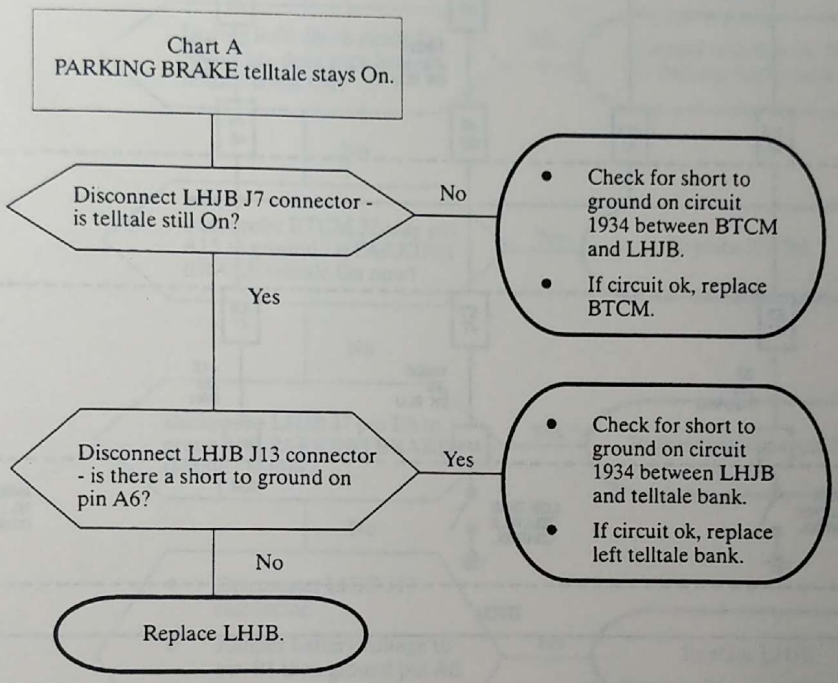
Chart A
PARKING BRAKE telltale stays On.
Disconnect LHJB J7 connector - is telltale still On?
No
Check for short to ground on circuit 1934 between BTCM and LHJB.
If circuit ok, replace BTCM.
Yes
Disconnect LHJB J13 connector - is there a short to ground on pin A6?
Yes
Check for short to ground on circuit 1934 between LHJB and telltale bank.
If circuit ok, replace left telltale bank.
No
Replace LHJB.

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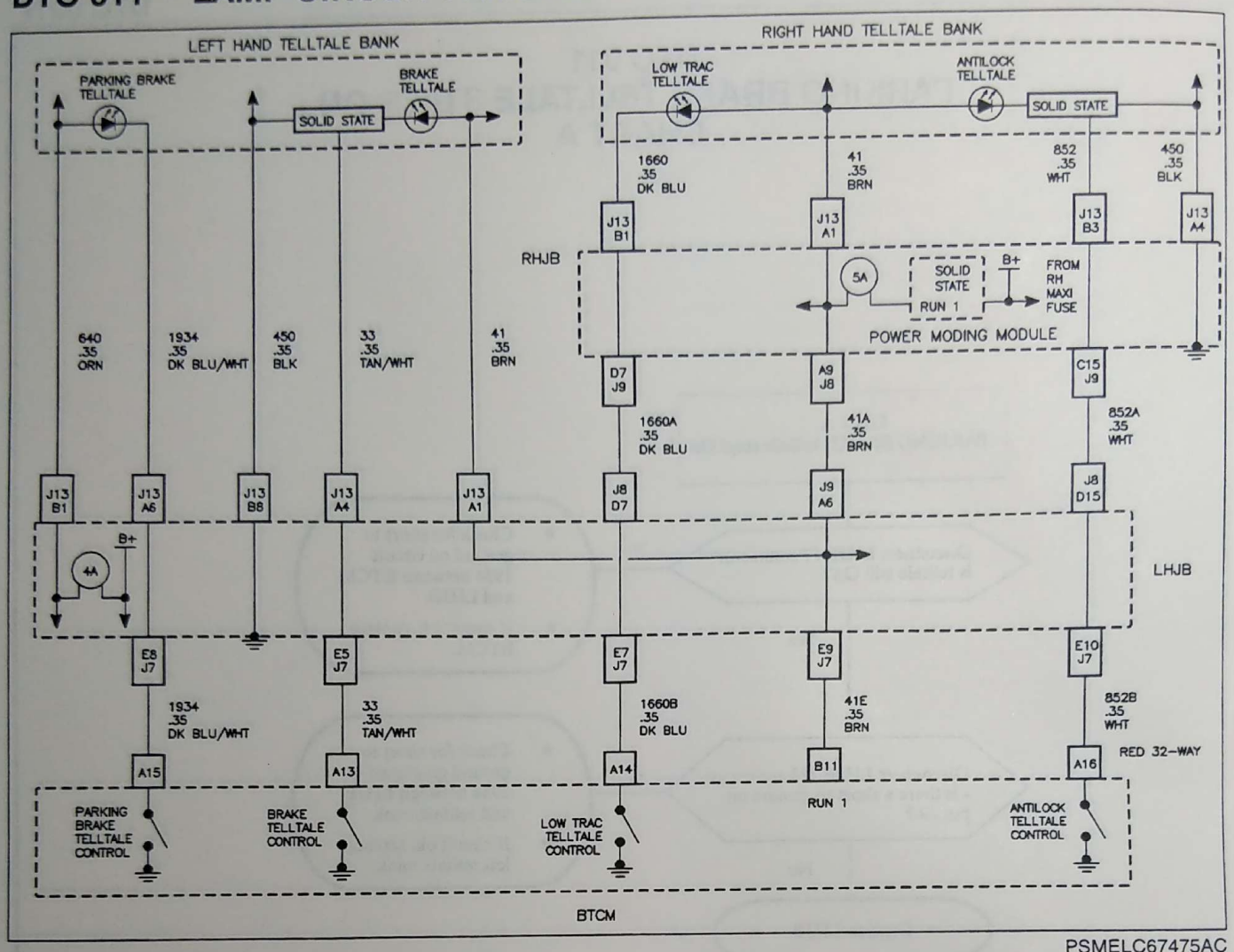
DTC 011 – LAMP CIRCUIT FAILURE



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LAMP CIRCUIT FAILURE – CHART B

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

DTC 11 will set if:
An open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side DRIVER is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 011
PARKING BRAKE TELLTALE INOPERATIVE
CHART B

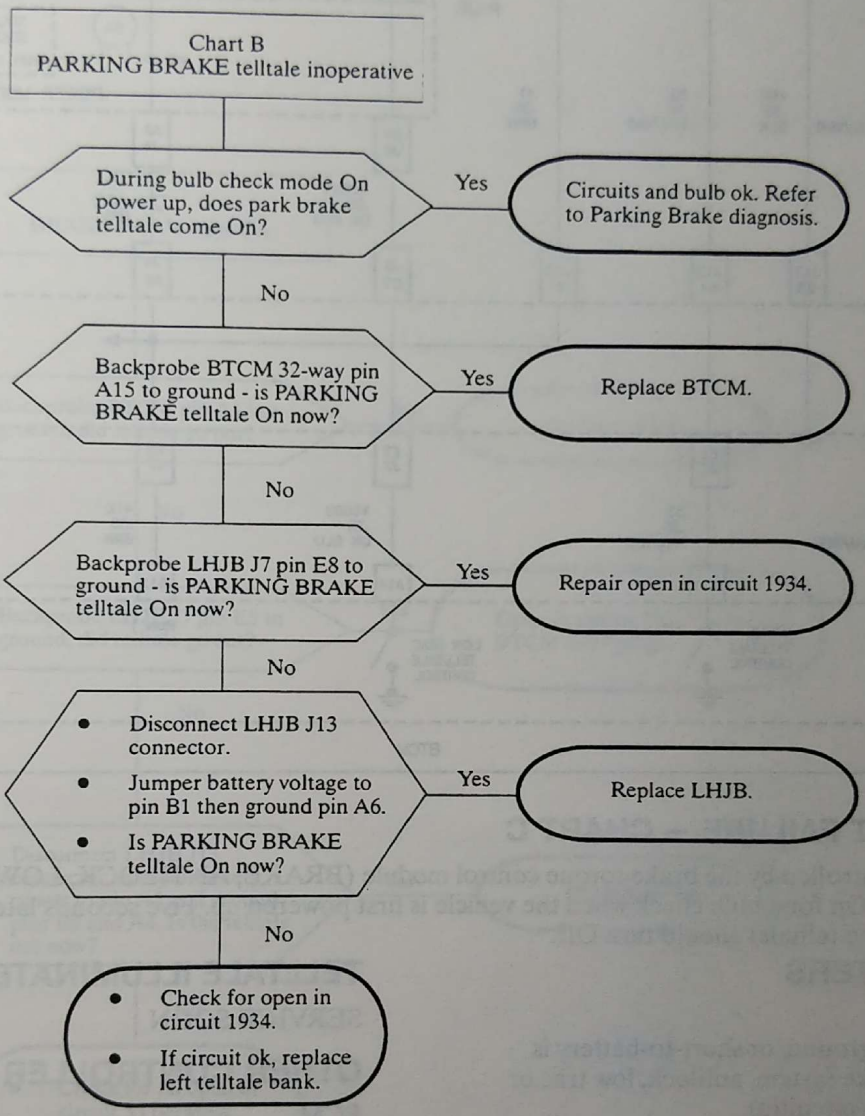
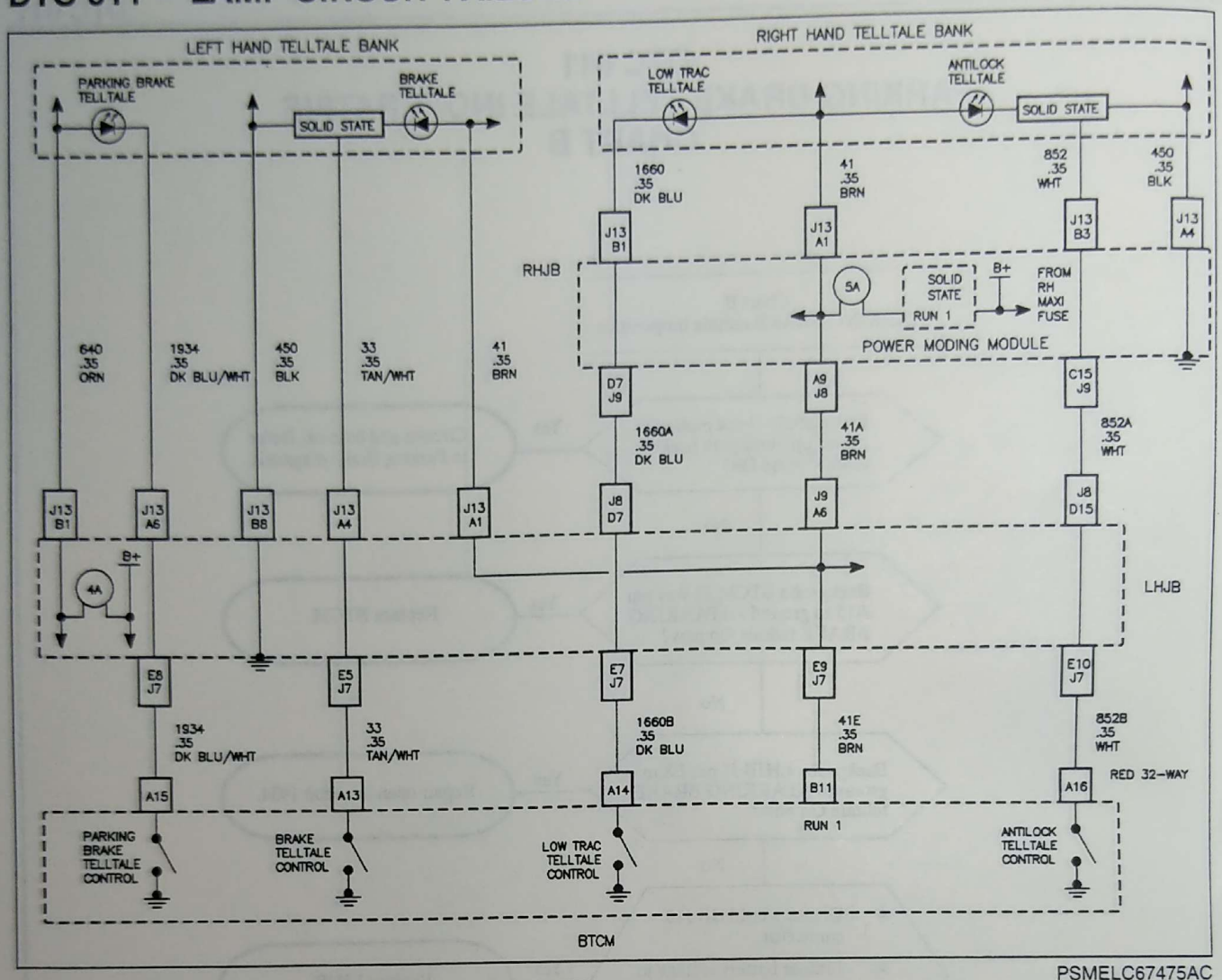


Chart B
PARKING BRAKE telltale inoperative
During bulb check mode On power up, does park brake telltale come On?
Yes
Circuits and bulb ok. Refer to Parking Brake diagnosis.
No
Backprobe BTCM 32-way pin A15 to ground - is PARKING BRAKE telltale On now?
Yes
Replace BTCM.
No
Backprobe LHJB J7 pin E8 to ground - is PARKING BRAKE telltale On now?
Yes
Repair open in circuit 1934.
No
Disconnect LHJB J13 connector.
Jumper battery voltage to pin B1 then ground pin A6.
Is PARKING BRAKE telltale On now?
Yes
Replace LHJB.
No
Check for open in circuit 1934.
If circuit ok, replace left telltale bank.

DTC 011 – LAMP CIRCUIT FAILURE



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LAMP CIRCUIT FAILURE – CHART C

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

DTC 11 will set if:
An open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 011
BRAKE TELLTALE STAYS ON
CHART C

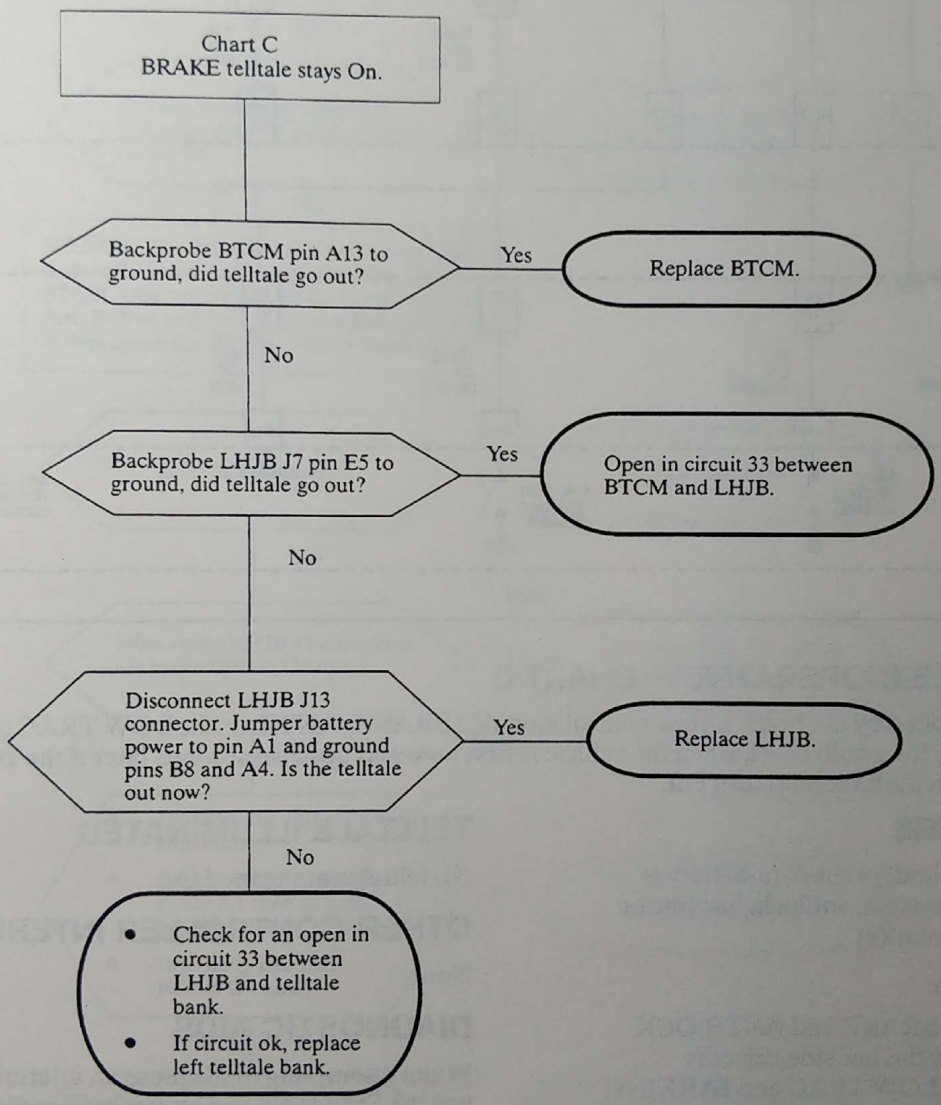
Chart C
BRAKE telltale stays On.
Backprobe BTCM pin A13 to ground, did telltale go out?
Yes
Replace BTCM.
No
Backprobe LHJB J7 pin E5 to ground, did telltale go out?
Yes
Open in circuit 33 between BTCM and LHJB.
No
Disconnect LHJB J13 connector. Jumper battery power to pin A1 and ground pins B8 and A4. Is the telltale out now?
Yes
Replace LHJB.
No
• Check for an open in circuit 33 between LHJB and telltale bank.
• If circuit ok, replace left telltale bank.

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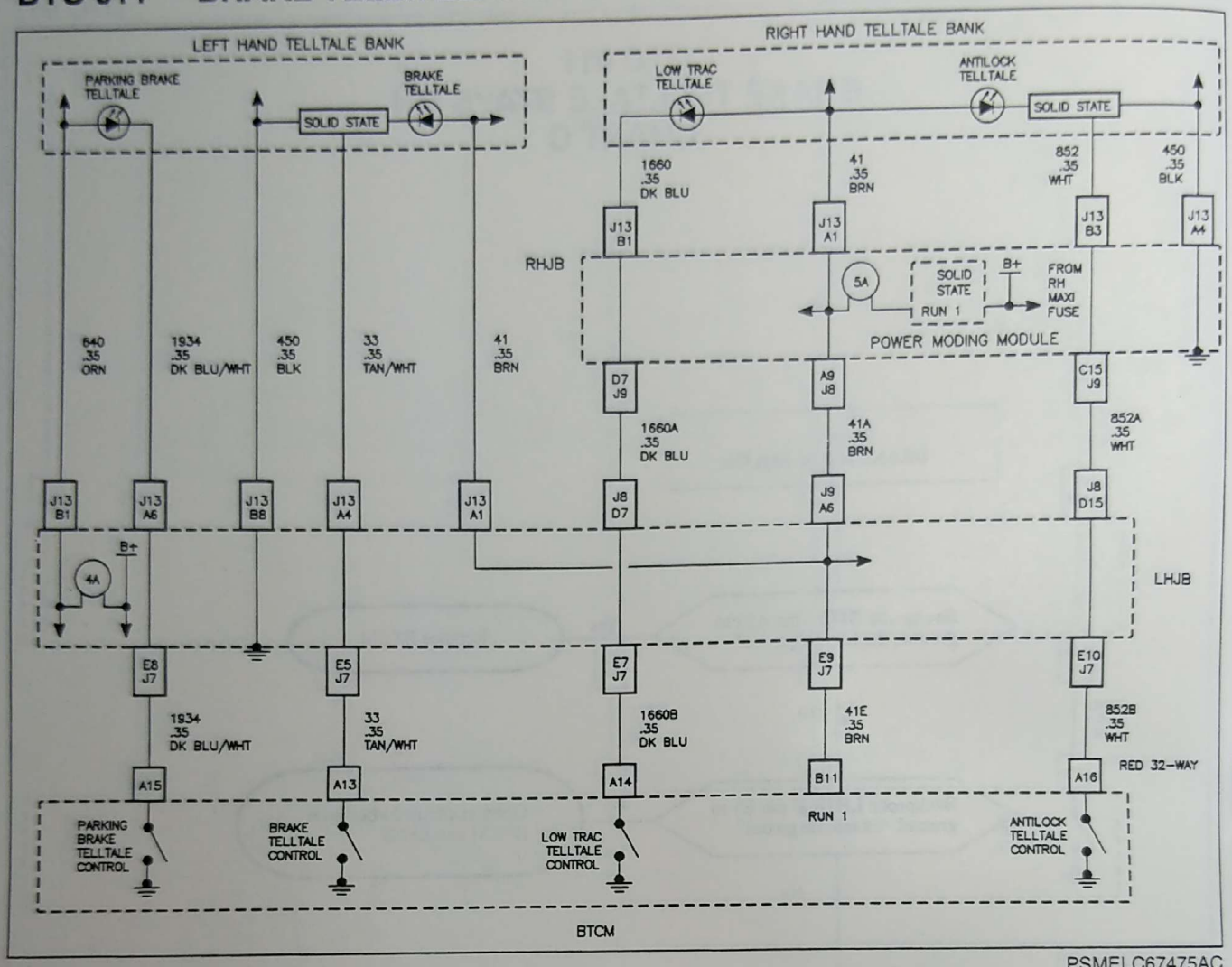
DTC 011 – BRAKE TELLTALE INOPERATIVE



PSMELC67475AC

BRAKE TELLTALE INOPERATIVE – CHART D

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

All open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

No telltales are turned On.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 011
BRAKE TELLTALE INOPERATIVE
CHART D

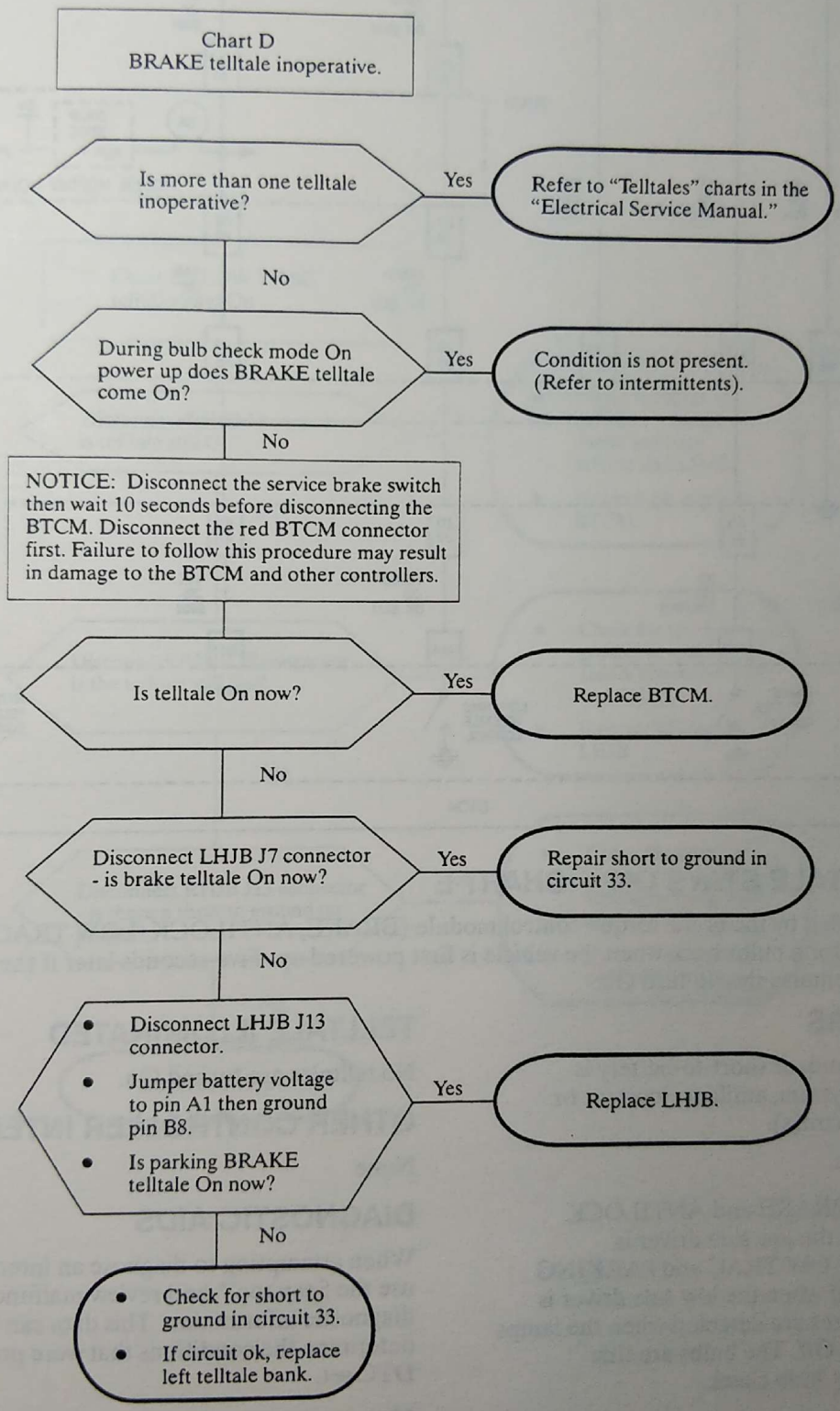


Chart D
BRAKE telltale inoperative.
Is more than one telltale inoperative?
Yes
Refer to "Telltales" charts in the "Electrical Service Manual."
No
During bulb check mode On power up does BRAKE telltale come On?
Yes
Condition is not present. (Refer to intermittents).
No
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is telltale On now?
Yes
Replace BTCM.
No
Disconnect LHJB J7 connector - is brake telltale On now?
Yes
Repair short to ground in circuit 33.
No
• Disconnect LHJB J13 connector.
• Jumper battery voltage to pin A1 then ground pin B8.
• Is parking BRAKE telltale On now?
Yes
Replace LHJB.
No
• Check for short to ground in circuit 33.
• If circuit ok, replace left telltale bank.

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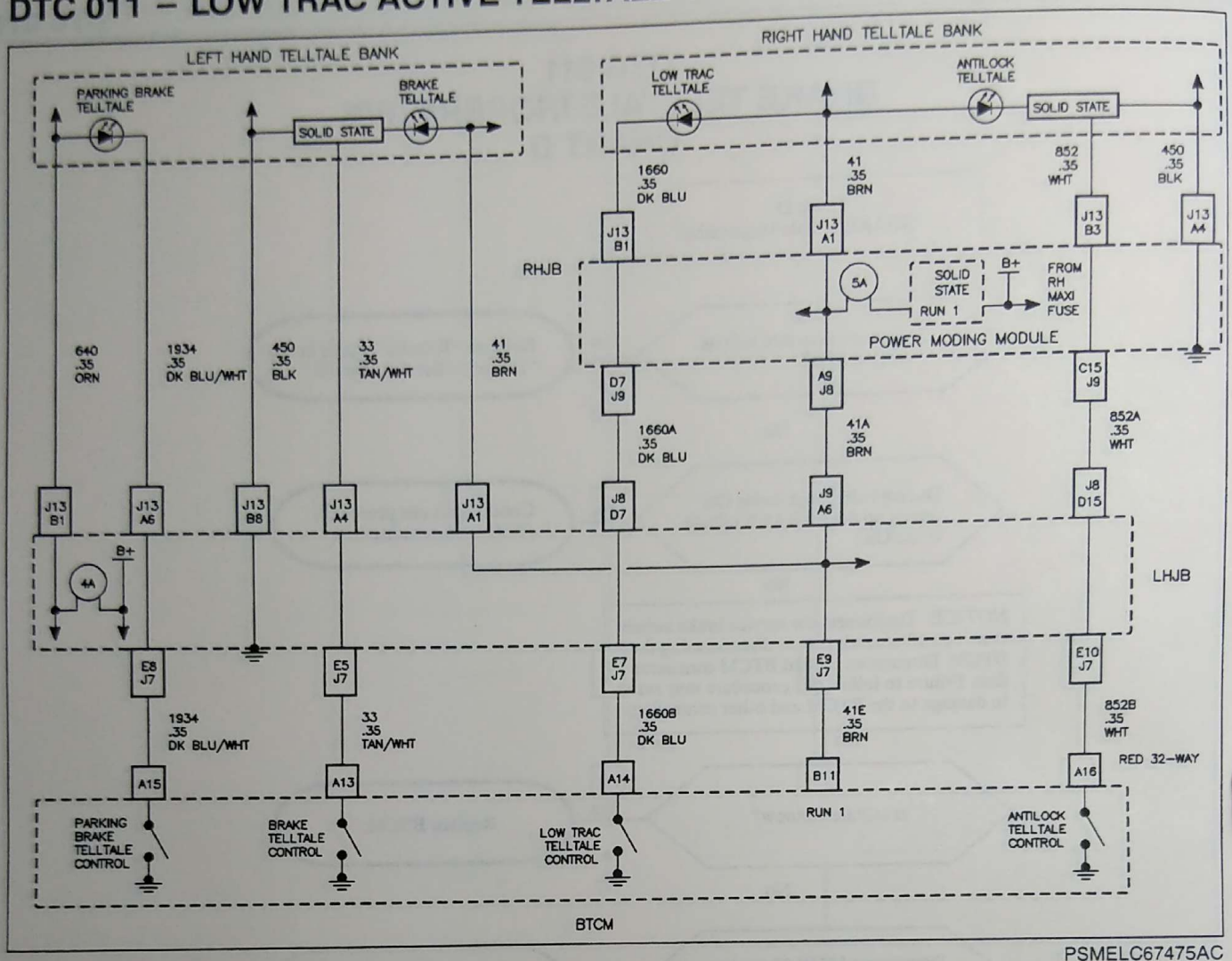
DTC 011 – LOW TRAC ACTIVE TELLTALE STAYS ON



PSMELC67475AC

LOW TRAC TELLTALE STAYS ON – CHART E

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

All open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

No telltales are turned On.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

CamScanner

DTC 011
LOW TRAC TELLTALE STAYS ON
CHART E

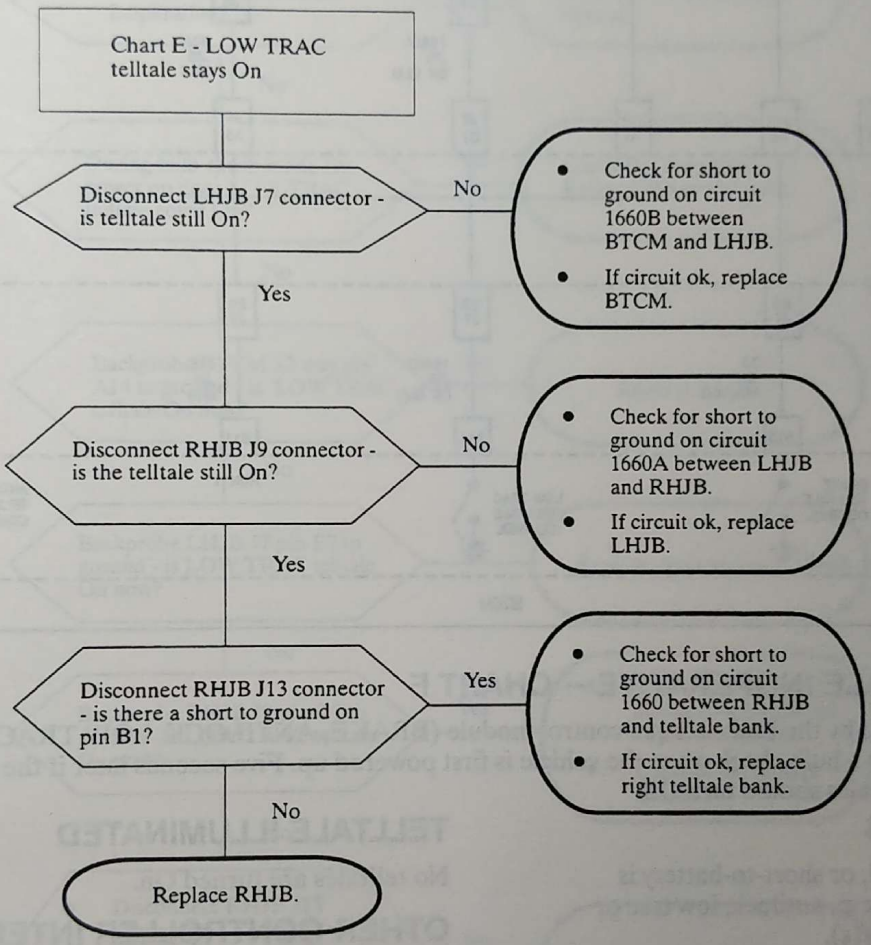
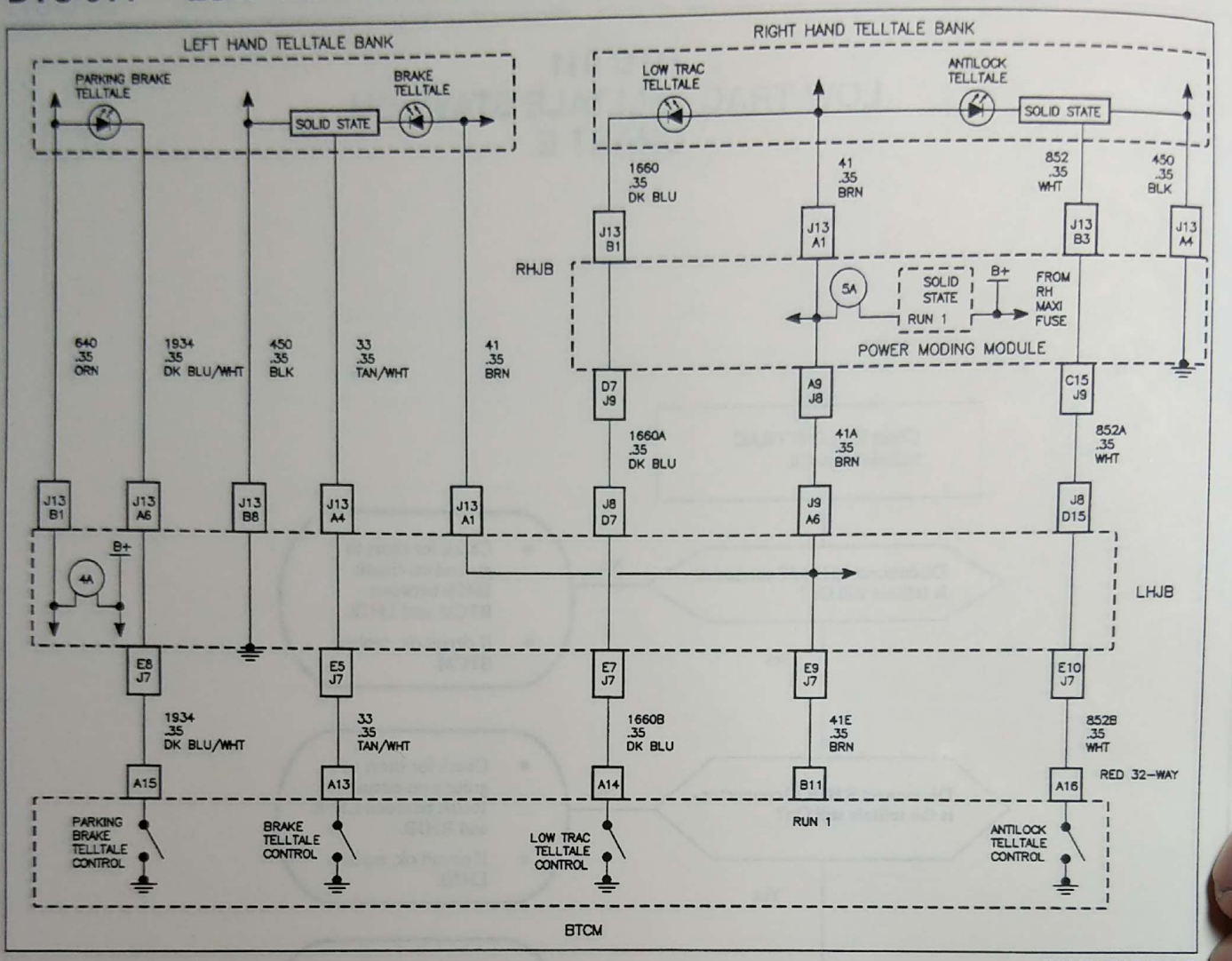


Chart E - LOW TRAC telltale stays On
Disconnect LHJB J7 connector - is telltale still On?
No
Check for short to ground on circuit 1660B between BTCM and LHJB.
If circuit ok, replace BTCM.
Yes
Disconnect RHJB J9 connector - is the telltale still On?
No
Check for short to ground on circuit 1660A between LHJB and RHJB.
If circuit ok, replace LHJB.
Yes
Disconnect RHJB J13 connector - is there a short to ground on pin B1?
Yes
Check for short to ground on circuit 1660 between RHJB and telltale bank.
If circuit ok, replace right telltale bank.
No
Replace RHJB.

DTC 011 – LOW TRAC TELLTALE INOPERATIVE



PSMELC67475AC

LOW TRAC TELLTALE INOPERATIVE – CHART F

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

All open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

No telltales are turned On.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

CamScanner

DTC 011
LOW TRAC TELLTALE INOPERATIVE
CHART F

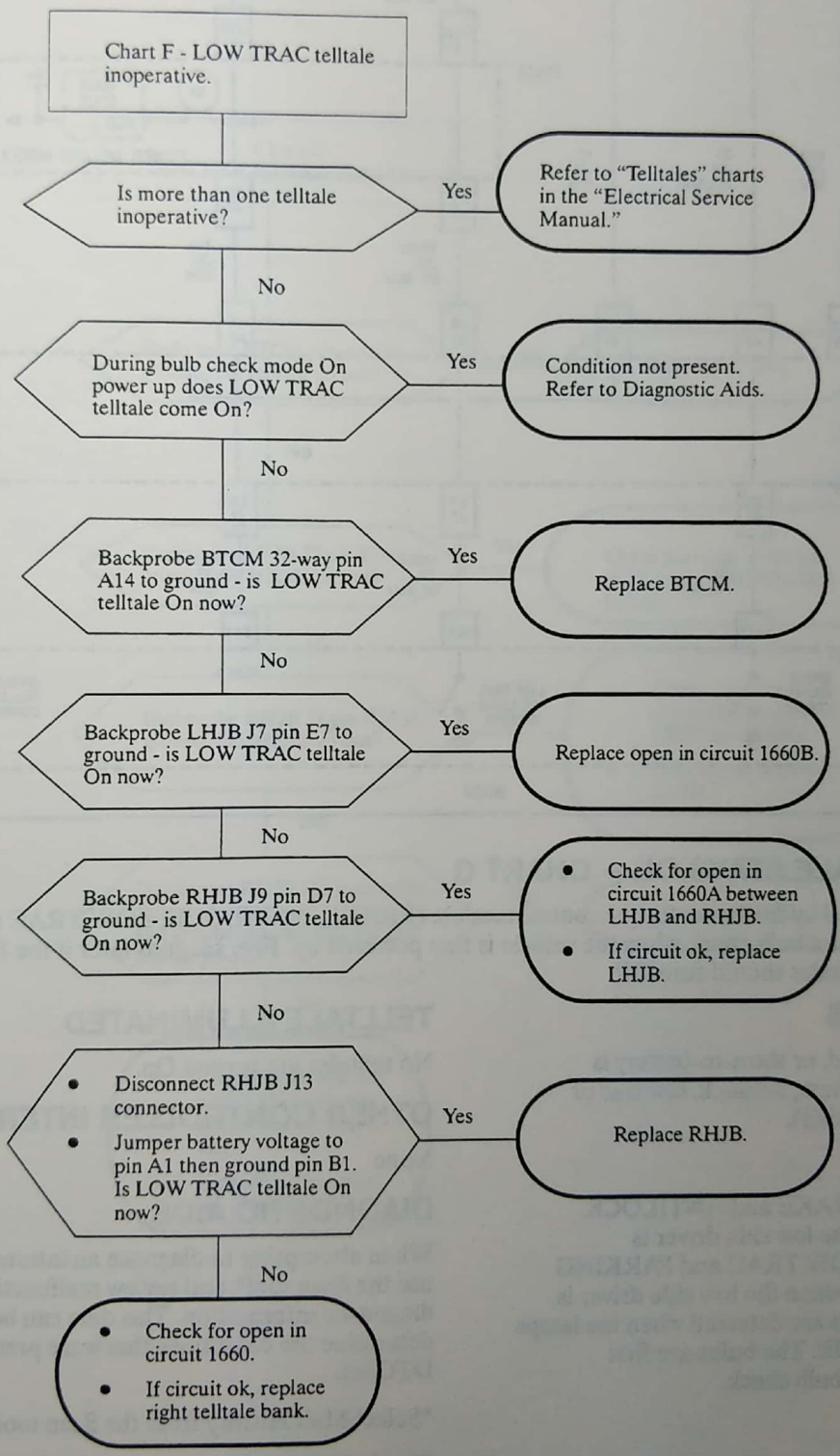
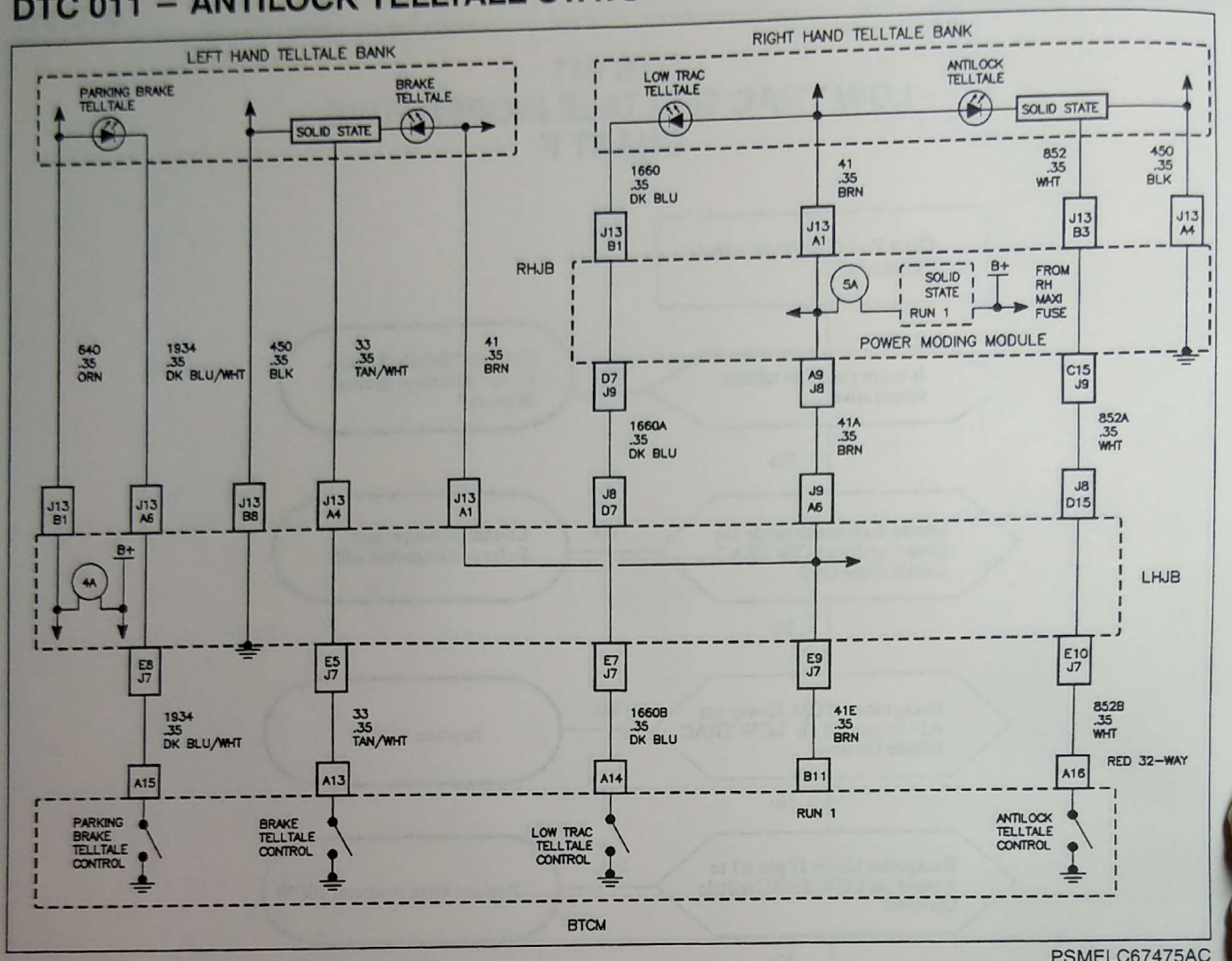


Chart F - LOW TRAC telltale inoperative.
Is more than one telltale inoperative?
Yes
Refer to "Telltales" charts in the "Electrical Service Manual."
No
During bulb check mode On power up does LOW TRAC telltale come On?
Yes
Condition not present. Refer to Diagnostic Aids.
No
Backprobe BTCM 32-way pin A14 to ground - is LOW TRAC telltale On now?
Yes
Replace BTCM.
No
Backprobe LHJB J7 pin E7 to ground - is LOW TRAC telltale On now?
Yes
Replace open in circuit 1660B.
No
Backprobe RHJB J9 pin D7 to ground - is LOW TRAC telltale On now?
Yes
• Check for open in circuit 1660A between LHJB and RHJB.
• If circuit ok, replace LHJB.
No
• Disconnect RHJB J13 connector.
• Jumper battery voltage to pin A1 then ground pin B1. Is LOW TRAC telltale On now?
Yes
Replace RHJB.
No
• Check for open in circuit 1660.
• If circuit ok, replace right telltale bank.

CamScanner

DTC 011 – ANTILOCK TELLTALE STAYS ON



PSMELC67475AC

ANTILOCK TELLTALE STAYS ON – CHART G

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

All open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

No telltales are turned On.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 011
ANTILOCK TELLTALE STAYS ON
CHART G

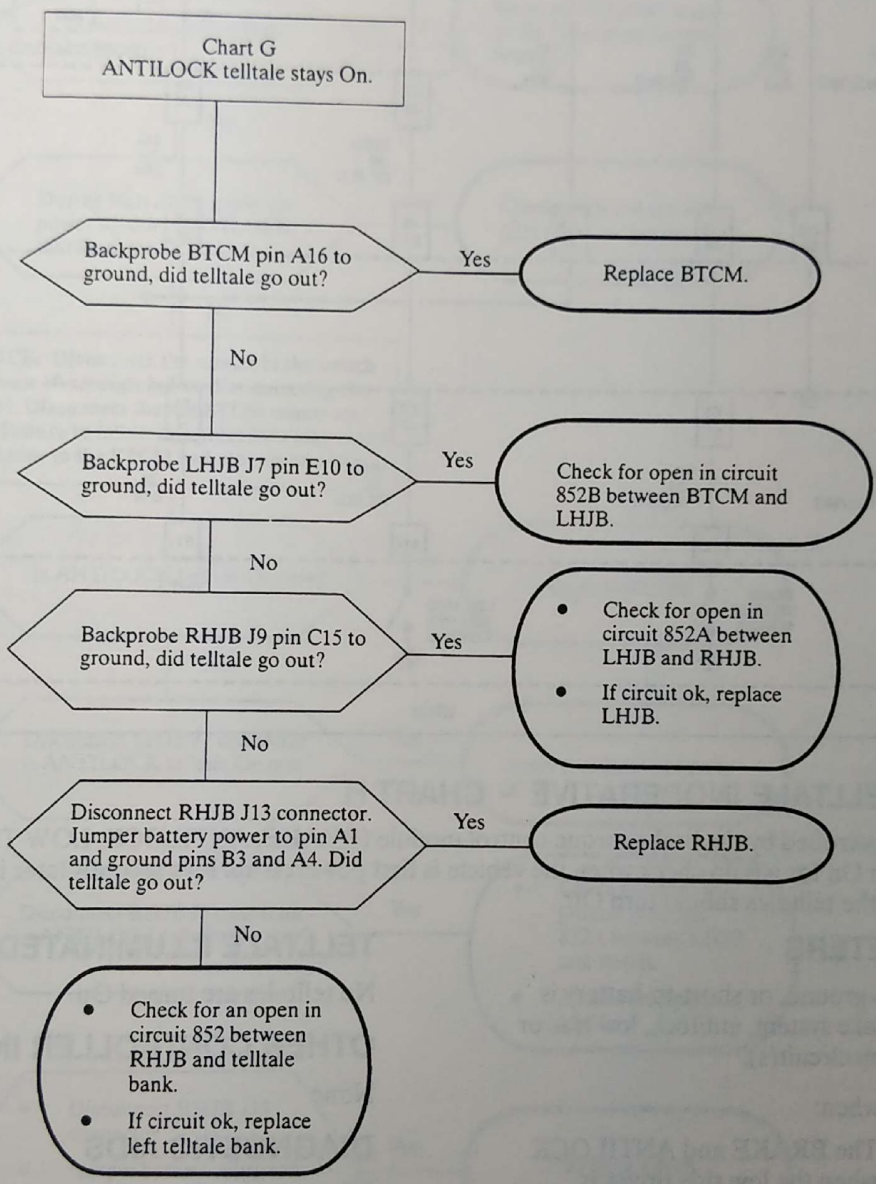
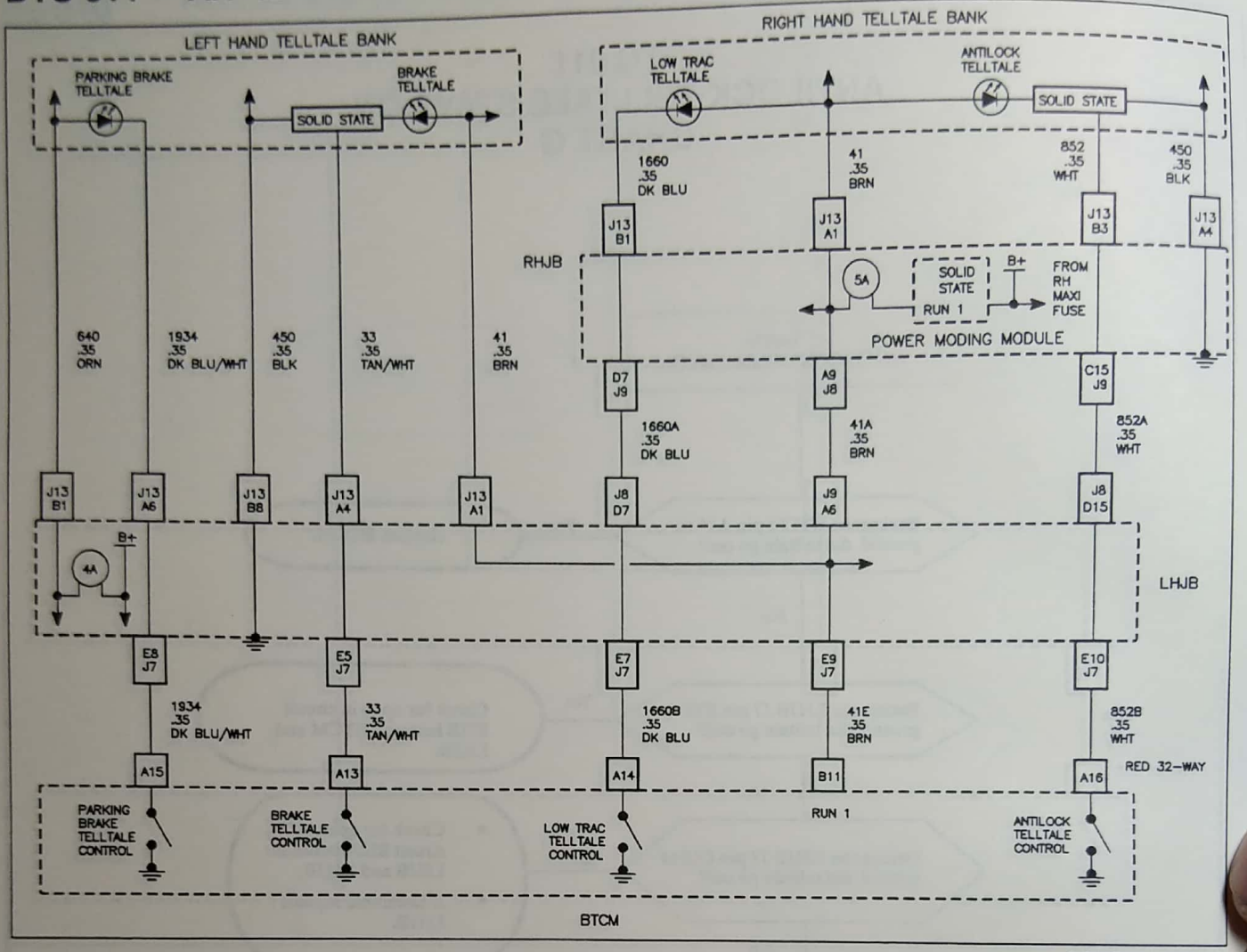


Chart G
ANTILOCK telltale stays On.
Backprobe BTCM pin A16 to ground, did telltale go out?
Yes
Replace BTCM.
No
Backprobe LHJB J7 pin E10 to ground, did telltale go out?
Yes
Check for open in circuit 852B between BTCM and LHJB.
No
Backprobe RHJB J9 pin C15 to ground, did telltale go out?
Yes
• Check for open in circuit 852A between LHJB and RHJB.
• If circuit ok, replace LHJB.
No
Disconnect RHJB J13 connector. Jumper battery power to pin A1 and ground pins B3 and A4. Did telltale go out?
Yes
Replace RHJB.
No
• Check for an open in circuit 852 between RHJB and telltale bank.
• If circuit ok, replace left telltale bank.

DTC 011 – ANTILOCK TELLTALE INOPERATIVE



PSMELC67475AC

ANTILOCK TELLTALE INOPERATIVE – CHART H

The four lamps controlled by the brake torque control module (BRAKE, ANTILOCK, LOW TRAC and PARKING BRAKE) will turn On for a bulb check when the vehicle is first powered up. Five seconds later if the BTCM does not detect a fault the telltales should turn Off.

DTC PARAMETERS

All open, short-to-ground, or short-to-battery is detected in the brake system, antilock, low trac or parking brake lamp circuit(s).

DTC 011 will set when:

Run 1 is present. The BRAKE and ANTILOCK LAMPS turn On when the low side driver is commanded Off. The LOW TRAC and PARKING BRAKE lamps turn Off when the low side driver is commanded Off. Failures are detected when the lamps are commanded On or Off. The bulbs are first commanded On during bulb check.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

No telltales are turned On.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 011
ANTILOCK TELLTALE INOPERATIVE
CHART H

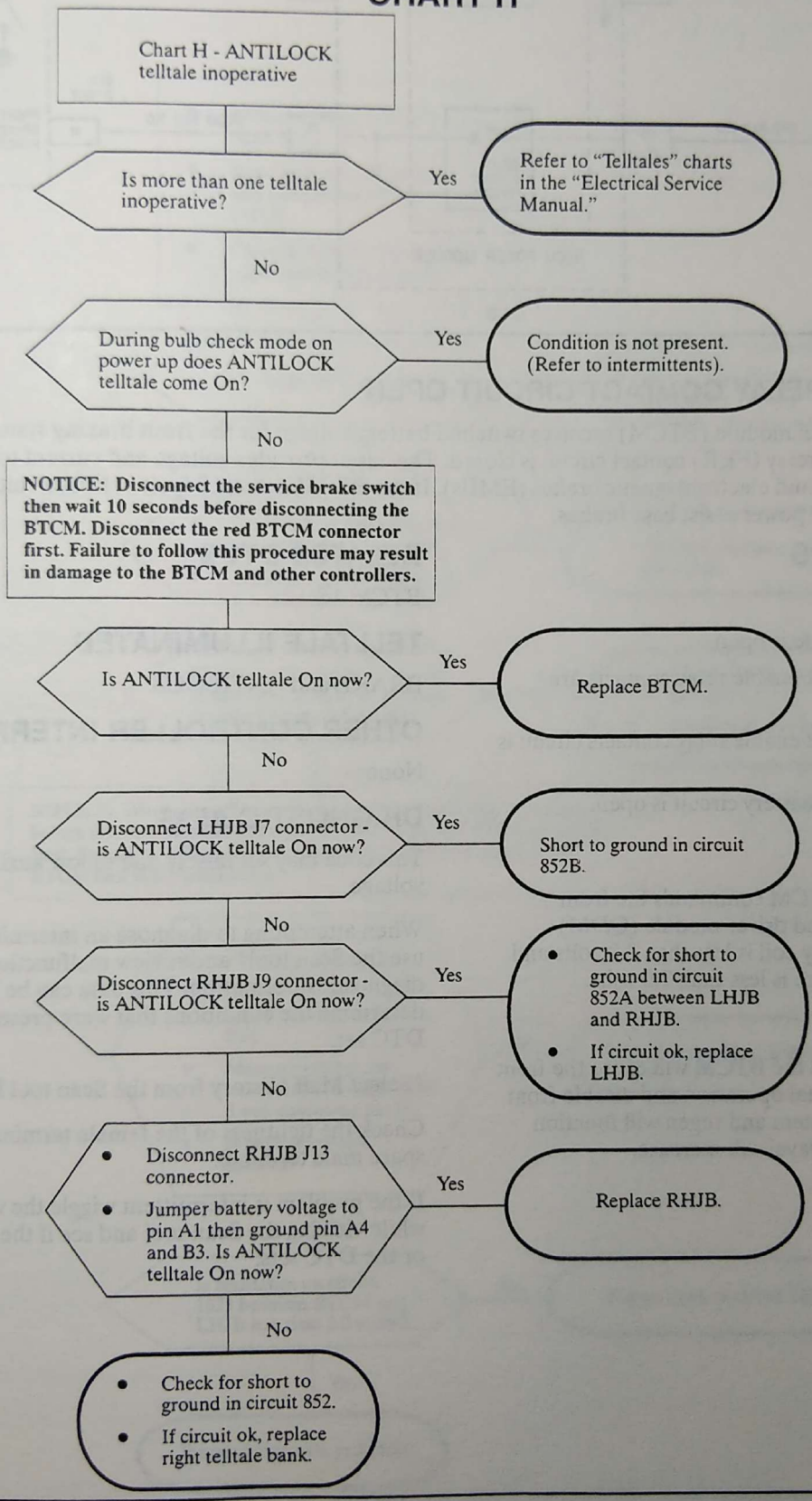


Chart H - ANTILOCK telltale inoperative
Is more than one telltale inoperative?
Yes
Refer to "Telltales" charts in the "Electrical Service Manual."
No
During bulb check mode on power up does ANTILOCK telltale come On?
Yes
Condition is not present. (Refer to intermittents).
No
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is ANTILOCK telltale On now?
Yes
Replace BTCM.
No
Disconnect LHJB J7 connector - is ANTILOCK telltale On now?
Yes
Short to ground in circuit 852B.
No
Disconnect RHJB J9 connector - is ANTILOCK telltale On now?
Yes
• Check for short to ground in circuit 852A between LHJB and RHJB.
• If circuit ok, replace LHJB.
No
• Disconnect RHJB J13 connector.
• Jumper battery voltage to pin A1 then ground pin A4 and B3. Is ANTILOCK telltale On now?
Yes
Replace RHJB.
No
• Check for short to ground in circuit 852.
• If circuit ok, replace right telltale bank.

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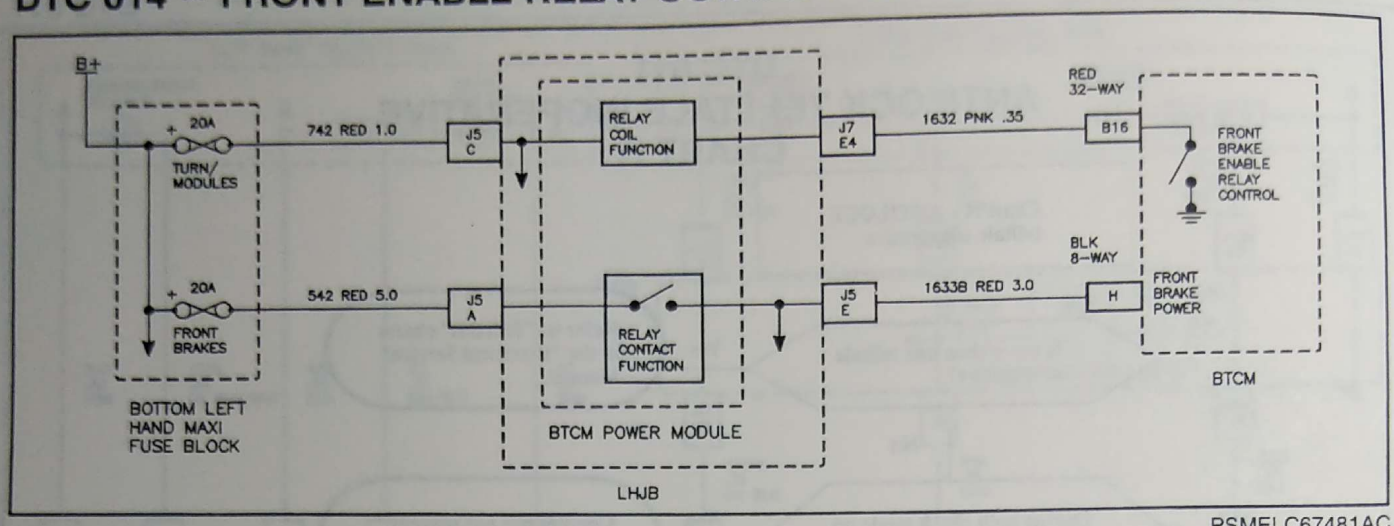
DTC 014 – FRONT ENABLE RELAY CONTACT CIRCUIT OPEN



PSMELC67481AC

FRONT ENABLE RELAY CONTACT CIRCUIT OPEN

The brake torque control module (BTCM) receives switched battery voltage for the front braking system when the solid state front enable relay (FER) contact circuit is closed. This input provides voltage and current to power the front motors, solenoids and electromagnetic brakes (EMBs). If the BTCM detects a fault in this circuit it will disable front ABS and the front power assist base brakes.

DTC PARAMETERS

DTC 014 will set if:

- The brakes front fuse is open.
- The solid state front enable relay contacts are open.
- The solid state front enable relay contacts circuit is open.
- The front switched battery circuit is open.

DTC 014 will set when:

Run 1 is present, the BTCM commands the front enable relay On, the quad driver module (QDM) output for the front relay coil is less than 3.0 volts and the front switched voltage is less than 7.0 volts.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 16

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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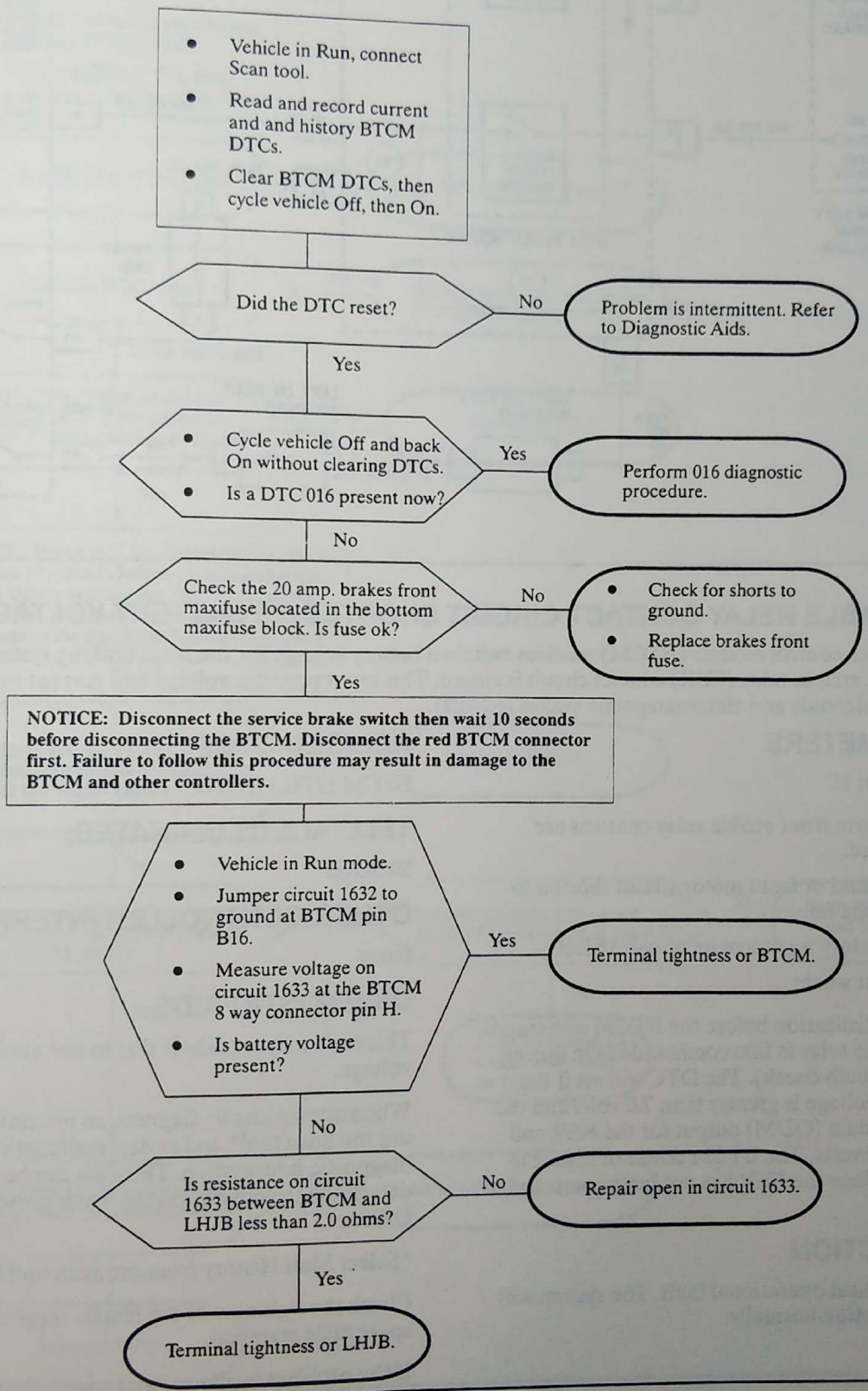
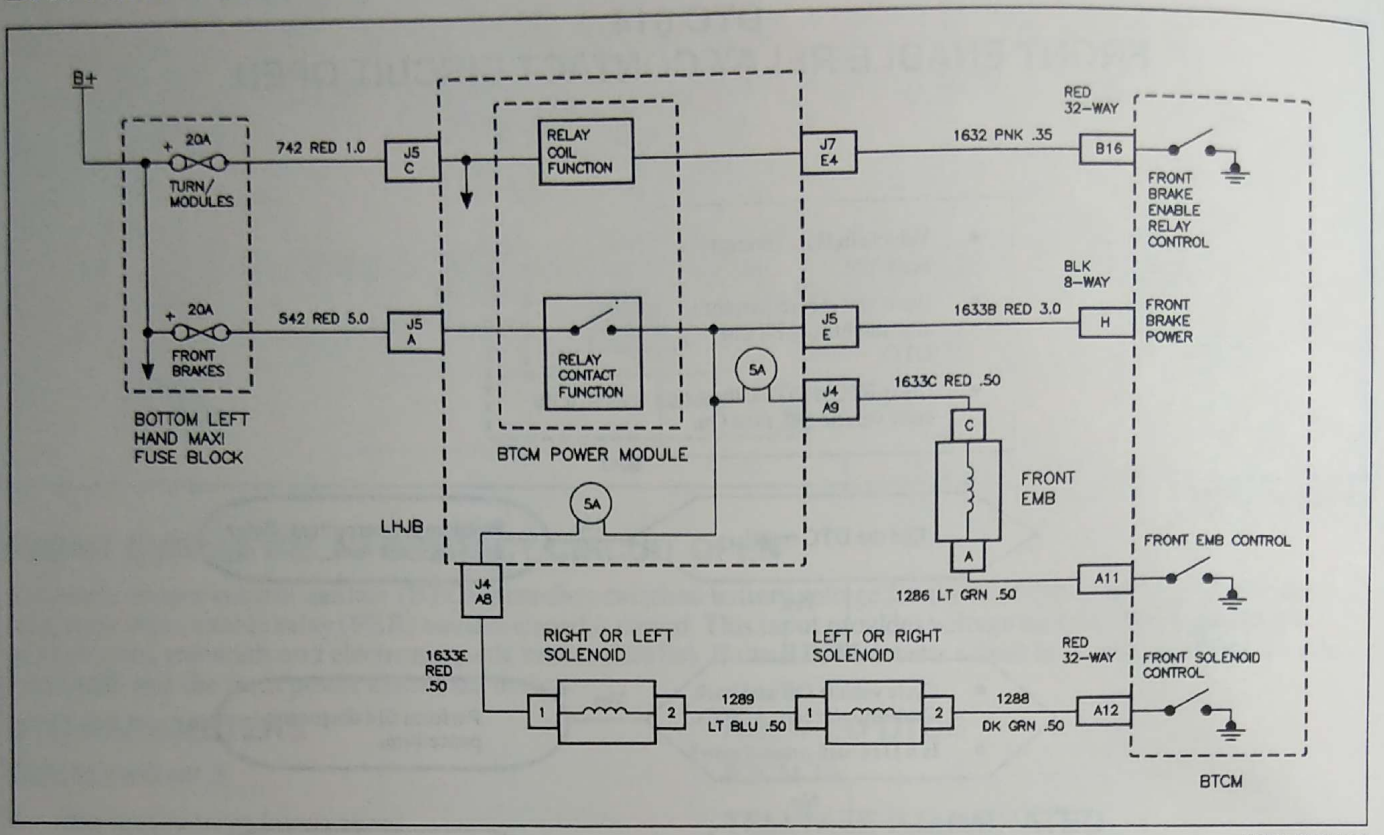
DTC 014
FRONT ENABLE RELAY CONTACT CIRCUIT OPEN


• Vehicle in Run, connect Scan tool.
• Read and record current and and history BTCM DTCs.
• Clear BTCM DTCs, then cycle vehicle Off, then On.
Did the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
• Cycle vehicle Off and back On without clearing DTCs.
• Is a DTC 016 present now?
Yes
Perform 016 diagnostic procedure.
No
Check the 20 amp. brakes front maxifuse located in the bottom maxifuse block. Is fuse ok?
No
• Check for shorts to ground.
• Replace brakes front fuse.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
• Vehicle in Run mode.
• Jumper circuit 1632 to ground at BTCM pin B16.
• Measure voltage on circuit 1633 at the BTCM 8 way connector pin H.
• Is battery voltage present?
Yes
Terminal tightness or BTCM.
No
Is resistance on circuit 1633 between BTCM and LHJB less than 2.0 ohms?
No
Repair open in circuit 1633.
Yes
Terminal tightness or LHJB.

CamScanner

DTC 015 – FRONT ENABLE RELAY CONTACT CIRCUIT SHORTED TO BATTERY VOLTAGE



PSMELC67483AC

FRONT ENABLE RELAY CONTACT CIRCUIT SHORTED TO BATTERY VOLTAGE

The brake torque control module (BTCM) receives switched battery voltage for the front braking system when the solid state front enable relay (FER) contact circuit is closed. This input provides voltage and current to power the front motors, solenoids and electromagnetic brakes (EMBs).

DTC PARAMETERS

DTC 015 will set if:

- The solid state front enable relay contacts are always closed.
- EMB, solenoid or front motor circuit shorted to battery (diode failure).
- Short-to-battery is present on circuit 1633B.

DTC 015 will set when:

Only during initialization before the BTCM commands the FER On (the relay is first commanded On during the five second bulb check). The DTC will set if the front switched voltage is greater than 7.0 volts and the quad driver module (QDM) output for the FER coil greater than 5.0 volts. The BTCM does not expect to detect voltage since the FER has not been commanded On.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

BTCM DTC 17, 68 or 77 may show up in history.

TELLTALE ILLUMINATED:

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 015
FRONT ENABLE RELAY CONTACT CIRCUIT SHORTED TO BATTERY VOLTAGE

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Is DTC 68 or 77 also set?
- Yes → Diagnose DTC 68 or 77.

Does the DTC reset?
- No → Problem is intermittent. Refer to Diagnostic Aids.
- Yes

Is battery voltage present at BTCM BLK 8 pin connector pin H backprobed in Lock mode?
- No → Replace BTCM.
- Yes

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

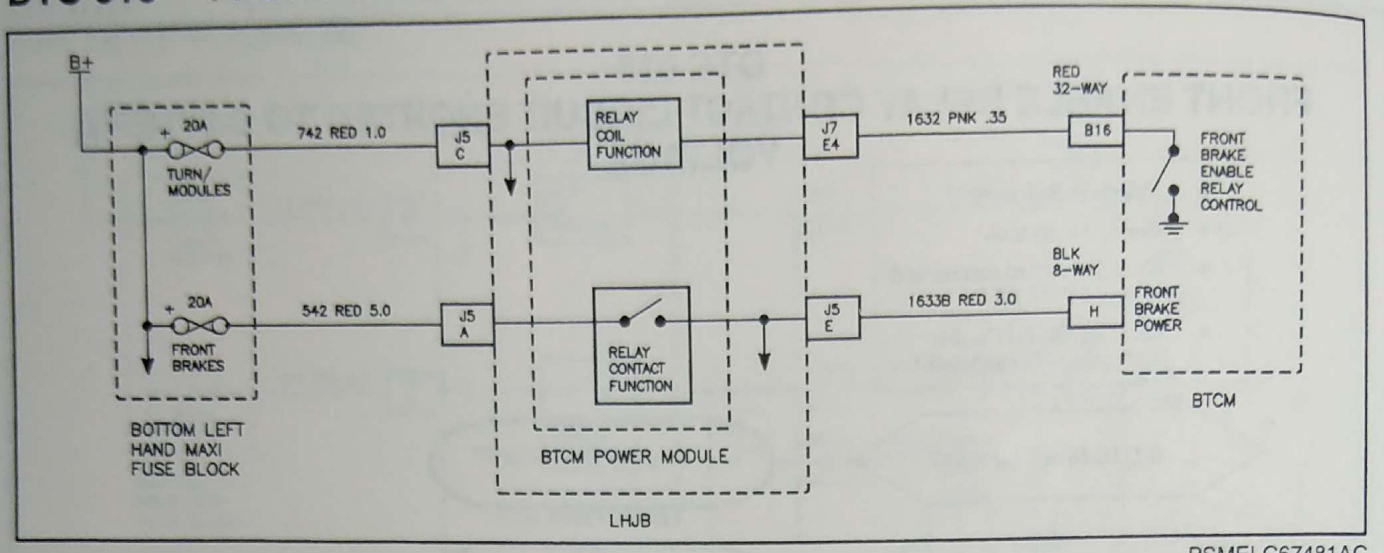
Does voltage on BTCM pin H still read battery voltage?
- No → Replace BTCM.
- Yes

Disconnect LHJB J4 connector - is battery voltage still present on BTCM pin H?
- No → Is battery voltage present on BTCM 32 pin connector pin A11?
  - Yes → Short to voltage on circuit 1633C or 1286.
  - No → Short to voltage on circuit 1288, 1289, or 1633E.
- Yes

Disconnect LHJB J5 connector - is voltage still present on BTCM pin H?
- Yes → Short to voltage on circuit 1633.
- No

Replace LHJB.

DTC 016 – FRONT ENABLE RELAY COIL CIRCUIT OPEN



PSMELC67481AC

FRONT ENABLE RELAY COIL CIRCUIT OPEN

The brake torque control module (BTCM) receives switched battery voltage for the front braking system when the solid state front enable relay (FER) contact circuit is closed. This input provides voltage and current to power the front motors, solenoids and electromagnetic brakes (EMBs). If the BTCM detects a fault in this circuit it will disable front ABS and the front power assist base brakes.

DTC PARAMETERS

DTC 016 will set if:

- The solid state front enable relay coil is open.
- The solid state front enable relay coil circuit is open.
- The BTCM circuit 1632 is malfunctioning.

DTC 016 will set when:

Run 1 is present, BTCM 014 has been set, FER switched voltage is less than 7.0 volts and the quad driver module (QDM) output for the FER is less than 5.0 volts for two seconds.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 014

TELLTALE ILLUMINATED:

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery conditions.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 016
FRONT ENABLE RELAY COIL CIRCUIT OPEN

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

Measure voltage on circuit 542 at LHJB J5 pin A. Is battery voltage present?

No → Circuit 542 open.

Yes

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

- Vehicle in Run mode.
- Jumper circuit 1632 to ground at BTCM pin B16.
- Measure voltage on circuit 1633 at the BTCM 8 way connector pin H.
- Is battery voltage present?

Yes → Terminal tightness or BTCM.

No

- Vehicle in lock mode.
- Remove jumper.
- Is resistance on circuit 1632 between BTCM and LHJB less than 2.0 ohms?

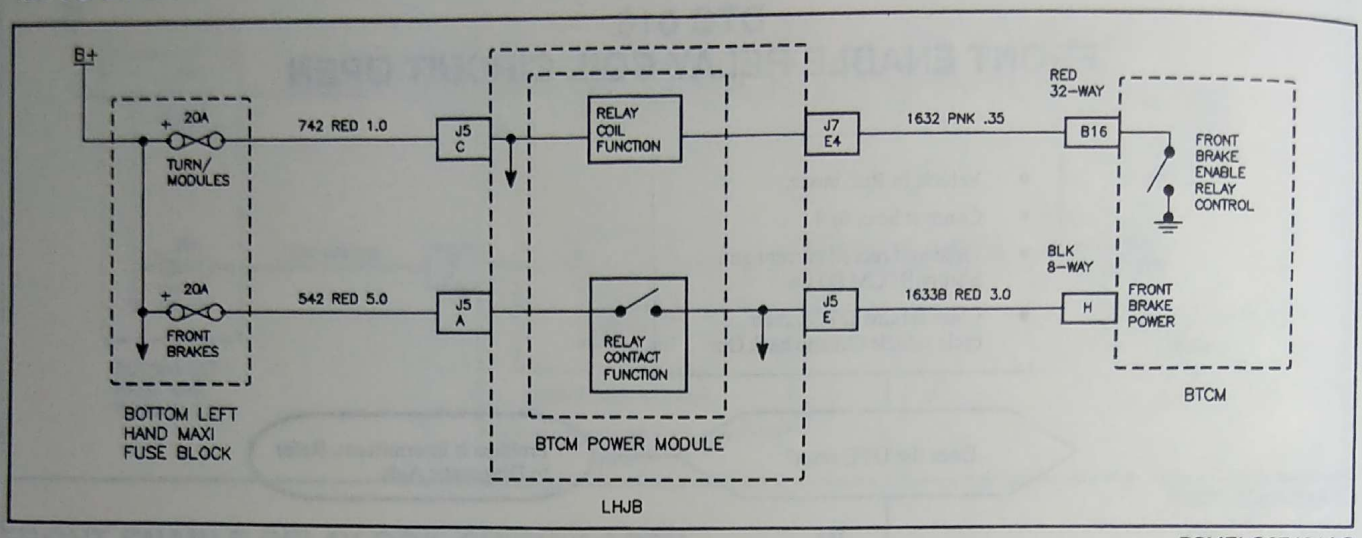
No → Repair open in circuit 1632.

Yes

Terminal tightness or LHJB.

CamScanner

DTC 017 – FRONT ENABLE RELAY CONTACT CIRCUIT SHORTED TO GROUND



PSMELC67481AC

FRONT ENABLE RELAY CONTACT CIRCUIT SHORTED TO GROUND

The brake torque control module (BTCM) receives Run 1 voltage when the solid state front enable relay (FER) contact circuit is closed. This input provides voltage and current to power the front motors, solenoids and electromagnetic brakes (EMBs).

DTC PARAMETERS

DTC 017 will set if:

- The solid state front enable relay coil circuit is shorted to ground.
- The BTCM driver circuit malfunctions.

DTC 017 will set when:

Only during initialization before the BTCM commands the FER On (the relay is first commanded On during the five second bulb check). The DTC will set if the front switched voltage is greater than 7.0 volts and the quad driver module (QDM) output for the FER coil greater than 5.0 volts. The BTCM expects 0.0 volts since the FER has not been commanded On.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

BTCM 15 may be set in history.

TELLTALE ILLUMINATED:

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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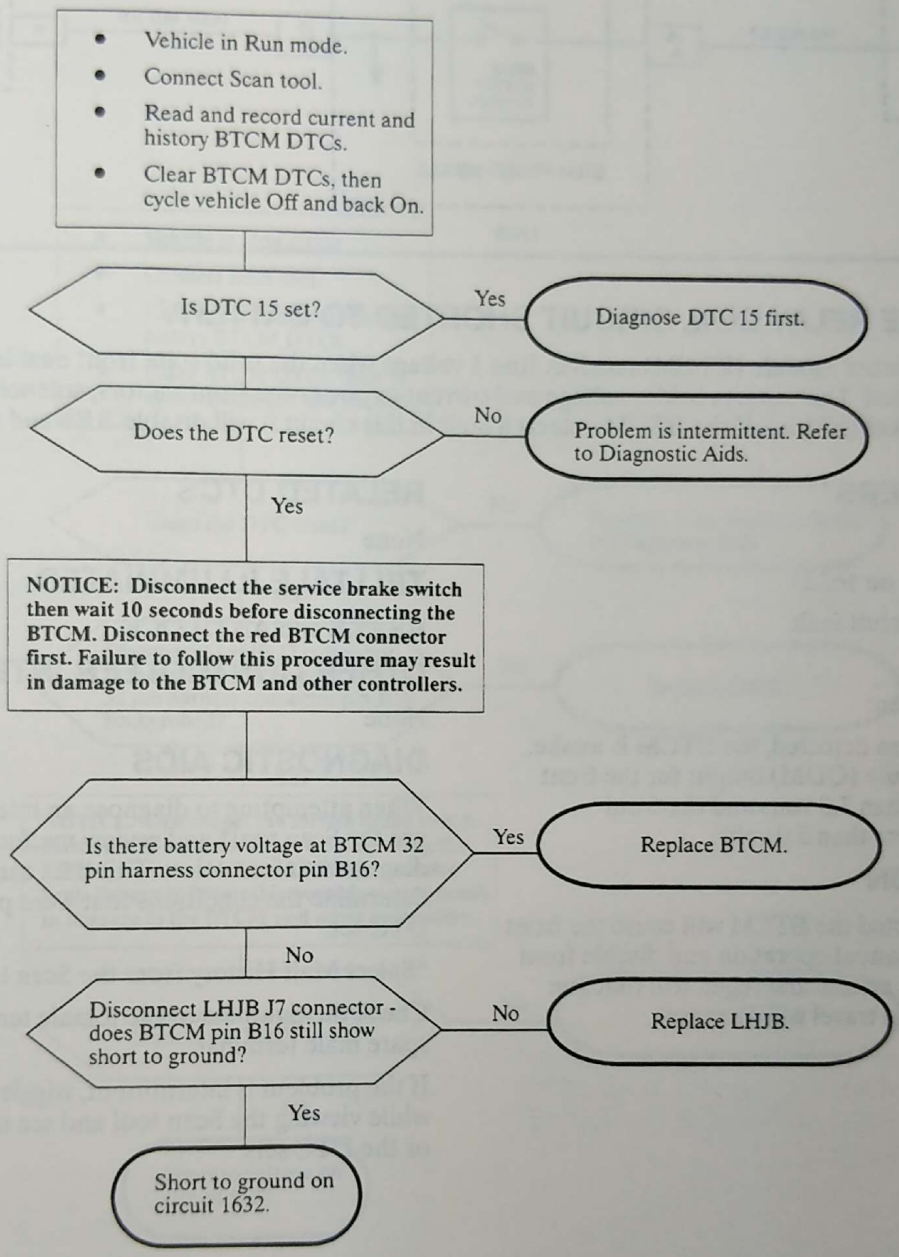
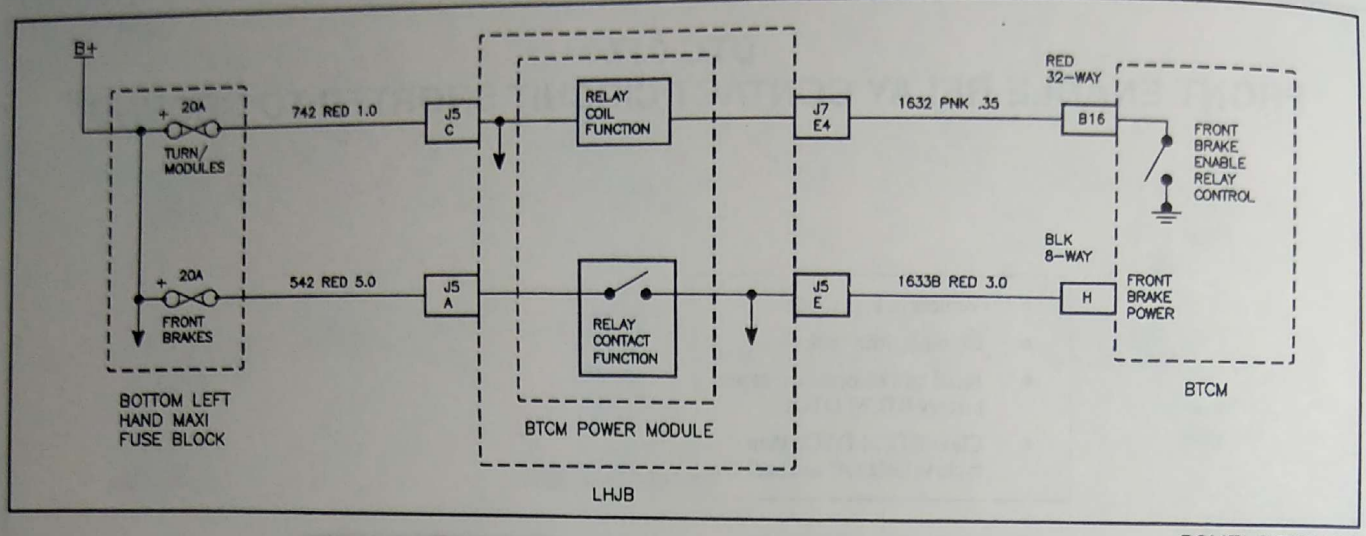
DTC 017
FRONT ENABLE RELAY CONTACT CIRCUIT SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Is DTC 15 set?
Yes
Diagnose DTC 15 first.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is there battery voltage at BTCM 32 pin harness connector pin B16?
Yes
Replace BTCM.
No
Disconnect LHJB J7 connector - does BTCM pin B16 still show short to ground?
No
Replace LHJB.
Yes
Short to ground on circuit 1632.

CamScanner

DTC 018 – FRONT ENABLE RELAY COIL CIRCUIT SHORTED TO BATTERY



PSMELC67481AC

FRONT ENABLE RELAY COIL CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) receives Run 1 voltage when the solid state front enable relay (FER) contact circuit is closed. This input provides voltage and current to power the front motors, solenoids and electromagnetic brakes (EMBs). If the BTCM detects a fault in this circuit it will disable ABS and the front power assist base brakes.

DTC PARAMETERS

DTC 018 will set if:

- Short to voltage on 1632.
- BTCM driver circuit fault
- LHJB fault

DTC 018 will set when:

DTC 014 has not been detected, the BTCM is awake, the quad driver module (QDM) output for the front relay coil is greater than 3.0 volts and the front switched voltage is less than 5.0 volts.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

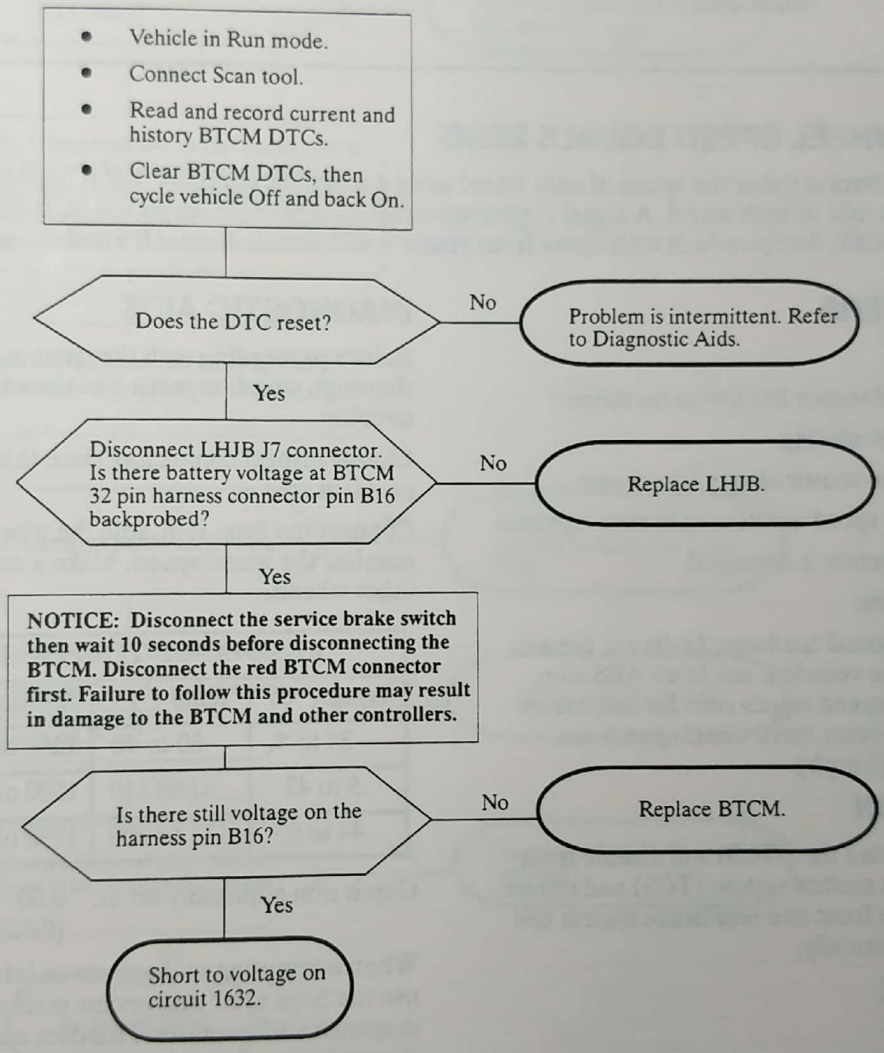
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent, wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

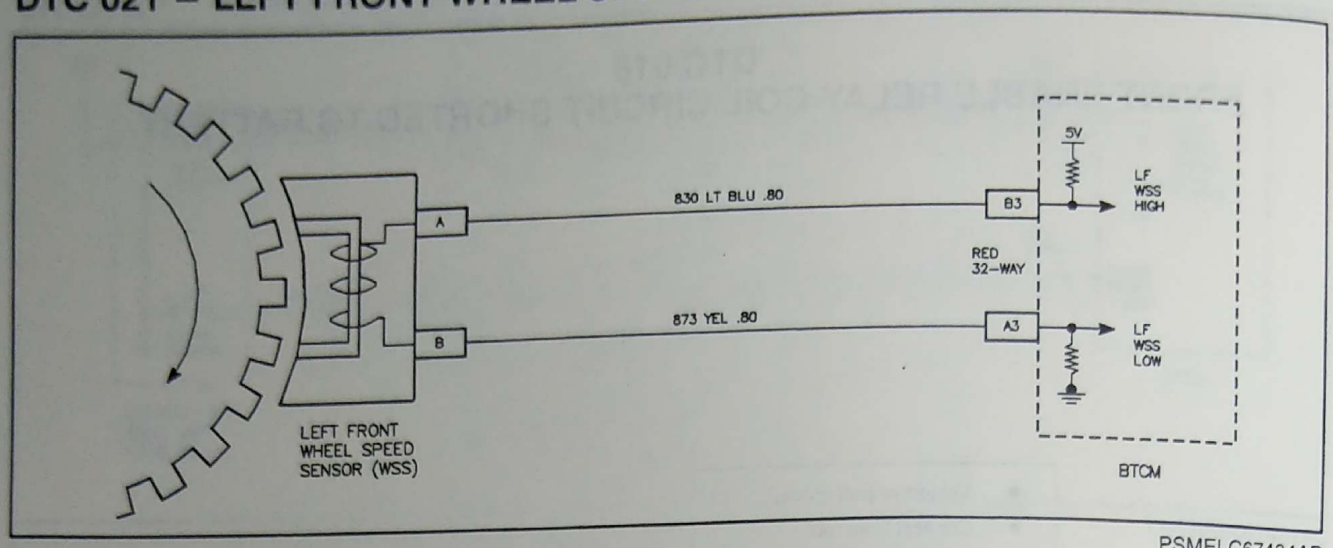
CamScanner

DTC 018
FRONT ENABLE RELAY COIL CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect LHJB J7 connector. Is there battery voltage at BTCM 32 pin harness connector pin B16 backprobed?
No
Replace LHJB.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is there still voltage on the harness pin B16?
No
Replace BTCM.
Yes
Short to voltage on circuit 1632.

CamScanner

DTC 021 – LEFT FRONT WHEEL SPEED EQUALS ZERO



PSMELC67484AB

LEFT FRONT WHEEL SPEED EQUALS ZERO

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a fault with either front sensor it will disable front ABS and the traction control system.

DTC PARAMETERS

DTC 021 will set if:

- The wheel speed sensor has low or no output.
- The speed ring is missing.
- The speed ring to sensor air gap is excessive.
- The front wheel speed inputs are shorted together.
- The sensor connector is damaged.

DTC 021 will set when:

No wheel speed electrical hardware faults are present (DTCs 31-35) and the vehicle is not in an ABS stop. The left front wheel speed equals zero for more than two seconds and the other three wheel speeds are greater than 8 km/h (5 mph).

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and the traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree, make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand and monitor the wheel speed. Make a comparison with other wheels.

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 021
LEFT FRONT WHEEL SPEED EQUALS ZERO

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Drive vehicle - does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

Check the resistance on RED 32-way connector between pins A3 and B3.

Is resistance below 1250 ohms?

Yes → Short between circuits 830 and 873 or faulty left front WSS.

No

Is resistance steady and between 1250 and 2500 ohms while tapping on WSS?

No → Replace left front WSS.

Yes

Check the speed ring and left front WSS. Is either damaged?

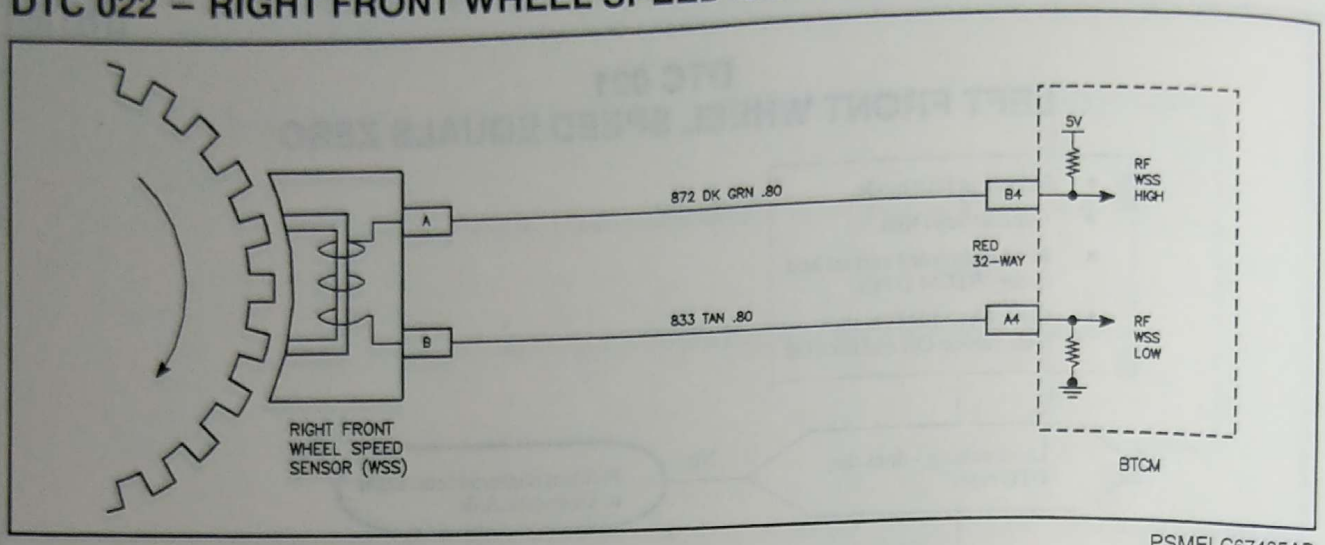
Yes → Replace damaged drive axle or WSS.

No

Replace BTCM.

CamScanner

DTC 022 – RIGHT FRONT WHEEL SPEED EQUALS ZERO



PSMELC67485AB

RIGHT FRONT WHEEL SPEED EQUALS ZERO

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a fault with either front sensor it will disable front ABS and the traction control system.

DTC PARAMETERS

DTC 022 will set if:

- The wheel speed sensor has low or no output.
- The speed ring is missing.
- The speed ring to sensor air gap is excessive.
- The front wheel speed inputs are shorted together.
- The sensor connector is damaged.

DTC 022 will set when:

No wheel speed electrical hardware faults are present (DTCs 31-35) and the vehicle is not in an ABS stop. The right front wheel speed equals zero for more than two seconds and the other three wheel speeds are greater than 8 km/h (5 mph).

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and the traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree, make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand, and monitor the wheel speed. Make a comparison with other wheels.

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

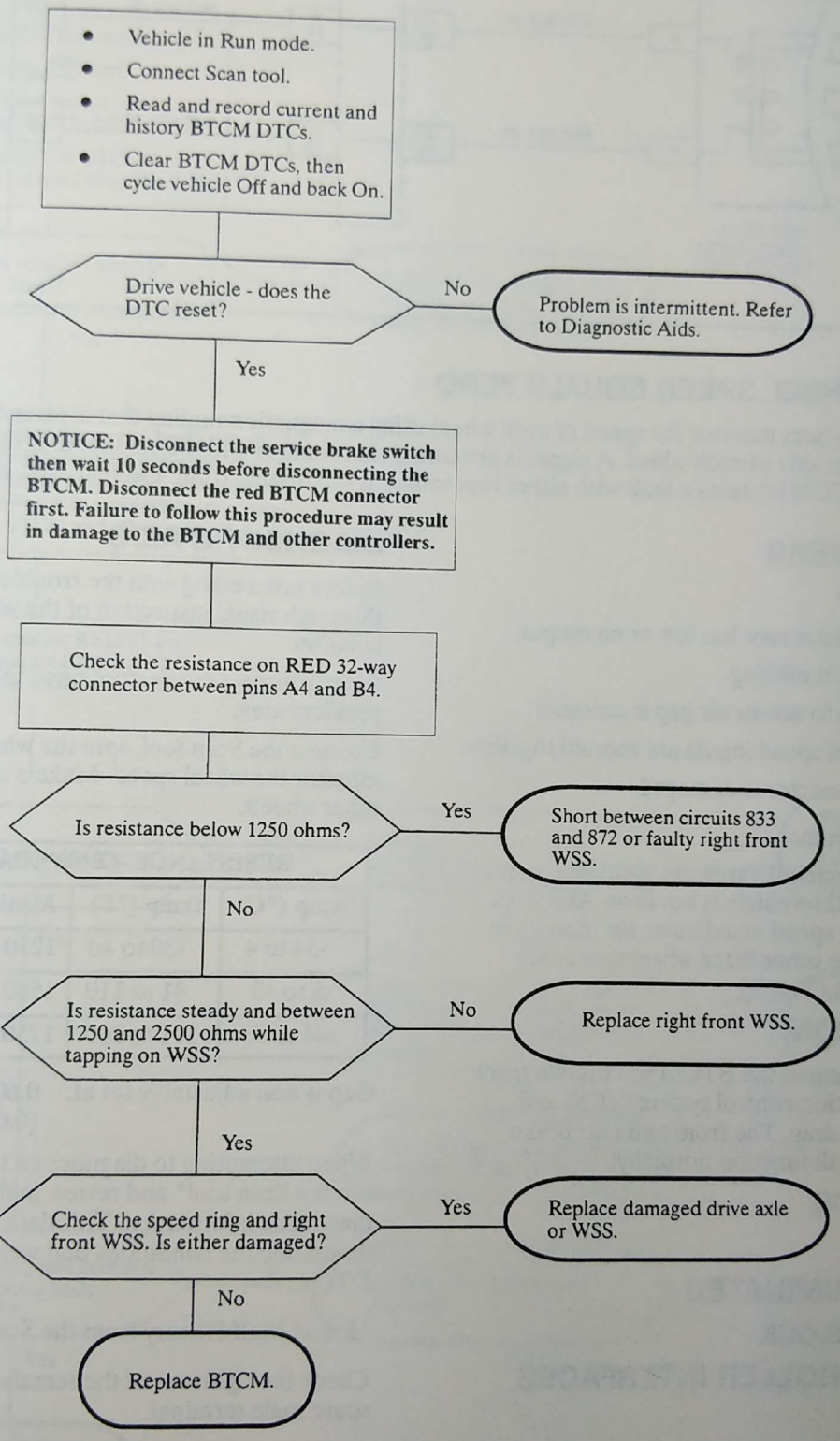
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

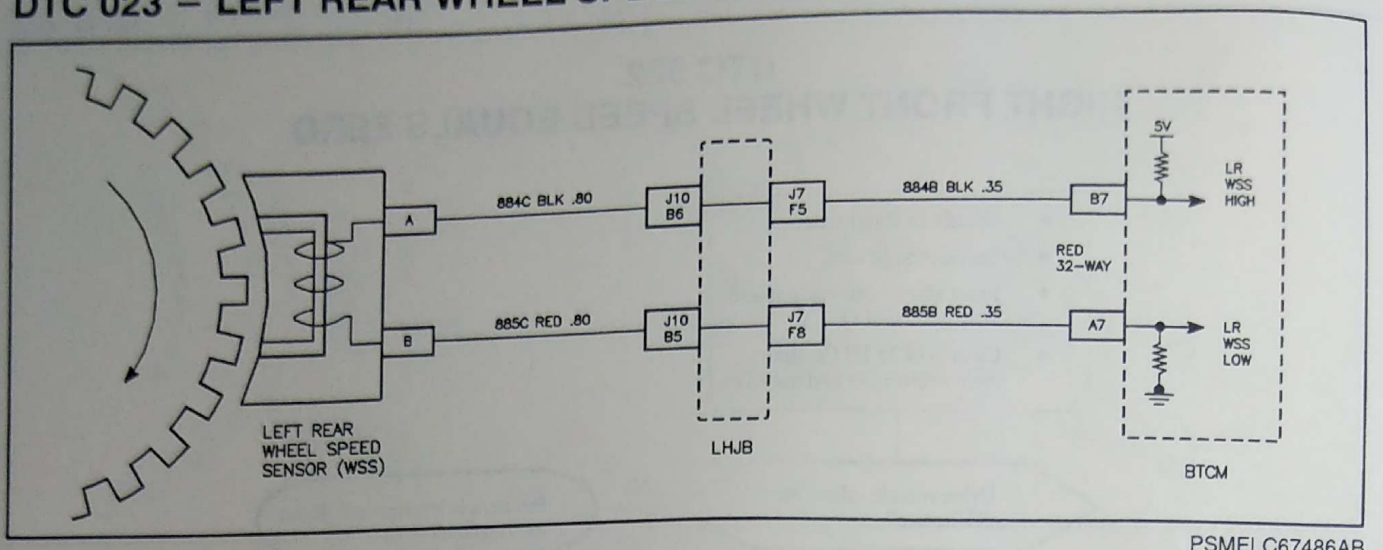
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent, wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 022
RIGHT FRONT WHEEL SPEED EQUALS ZERO


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Drive vehicle - does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Check the resistance on RED 32-way connector between pins A4 and B4.
Is resistance below 1250 ohms?
Yes
Short between circuits 833 and 872 or faulty right front WSS.
No
Is resistance steady and between 1250 and 2500 ohms while tapping on WSS?
No
Replace right front WSS.
Yes
Check the speed ring and right front WSS. Is either damaged?
Yes
Replace damaged drive axle or WSS.
No
Replace BTCM.

DTC 023 – LEFT REAR WHEEL SPEED EQUALS ZERO



PSMELC67486AB

LEFT REAR WHEEL SPEED EQUALS ZERO

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a fault with either rear sensor it will disable front and rear ABS and the traction control system.

DTC PARAMETERS

DTC 023 will set if:

- The wheel speed sensor has low or no output.
- The speed ring is missing.
- The speed ring to sensor air gap is excessive.
- The front wheel speed inputs are shorted together.
- The sensor connector is damaged.

DTC 023 will set when:

No wheel speed electrical hardware faults are present (DTCs 31-35) and the vehicle is not in an ABS stop. The left rear wheel speed equals zero for more than two seconds and the other three wheel speeds are greater than 8 km/h (5 mph).

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS, traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand and monitor the wheel speed. Make a comparison with other wheels.

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent, wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 023
LEFT REAR WHEEL SPEED EQUALS ZERO

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Drive vehicle - does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

Check the resistance on RED 32-way connector between pins A7 and B7.

Is resistance below 1250 ohms?

Yes → Disconnect WSS. Is there continuity between BTCM 32 pin connector pins A7 and B7?

No → Replace left rear WSS (part of rear hub/bearing assembly).

Yes

Disconnect LHJB J10 connector. Is there still continuity between BTCM 32 pin connector pins A7 and B7?

No → Short between circuits 884C and 885C.

Yes

Short between circuits 884B and 885B or faulty LHJB.

No

Is resistance steady and between 1250 and 2500 ohms while tapping on WSS?

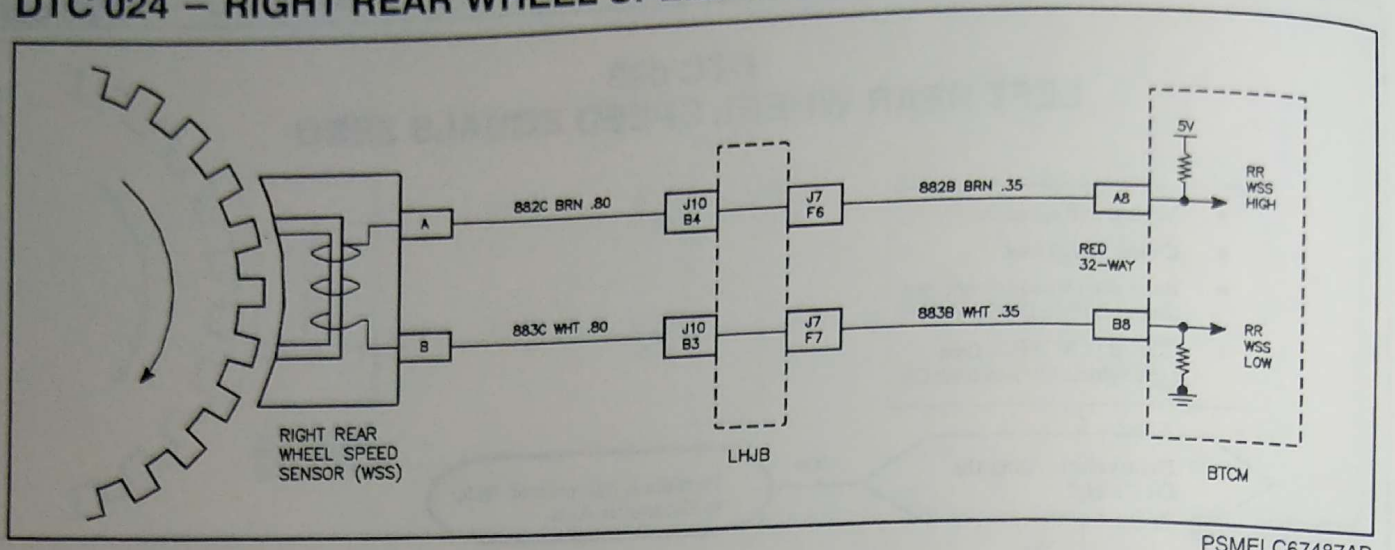
No → Replace left rear WSS (part of rear hub/bearing assembly).

Yes

Replace BTCM.

CamScanner

DTC 024 – RIGHT REAR WHEEL SPEED EQUALS ZERO



PSMELC67487AB

RIGHT REAR WHEEL SPEED EQUALS ZERO

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a fault with either rear sensor it will disable front and rear ABS and the traction control system.

DTC PARAMETERS

DTC 024 will set if:

- The wheel speed sensor has low or no output.
- The speed ring is missing.
- The speed ring to sensor air gap is excessive.
- The front wheel speed inputs are shorted together.
- The sensor connector is damaged.

DTC 024 will set when:

No wheel speed electrical hardware faults are present (DTCs 31-35) and the vehicle is not in an ABS stop. The left rear wheel speed equals zero for more than two seconds and the other three wheel speeds are greater than 8 km/h (5 mph).

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS, Traction Control System and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand and monitor the wheel speed. Make a comparison with other wheels.

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent, wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

CamScanner

DTC 024
RIGHT REAR WHEEL SPEED EQUALS ZERO

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Drive vehicle - does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

Check the resistance on RED 32-way connector between pins A8 and B8.

Is resistance below 1250 ohms?

Yes → Disconnect WSS. Is there continuity between BTCM 32 pin connector pins A6 and B6?

No → Replace right rear WSS (part of rear hub/bearing assembly).

Yes → Disconnect LHJB J10 connector. Is there still continuity between BTCM 32 pin connector pins A6 and B6?

No → Short between circuits 882C and 883C.

Yes → Short between circuits 882B and 883B or faulty LHJB.

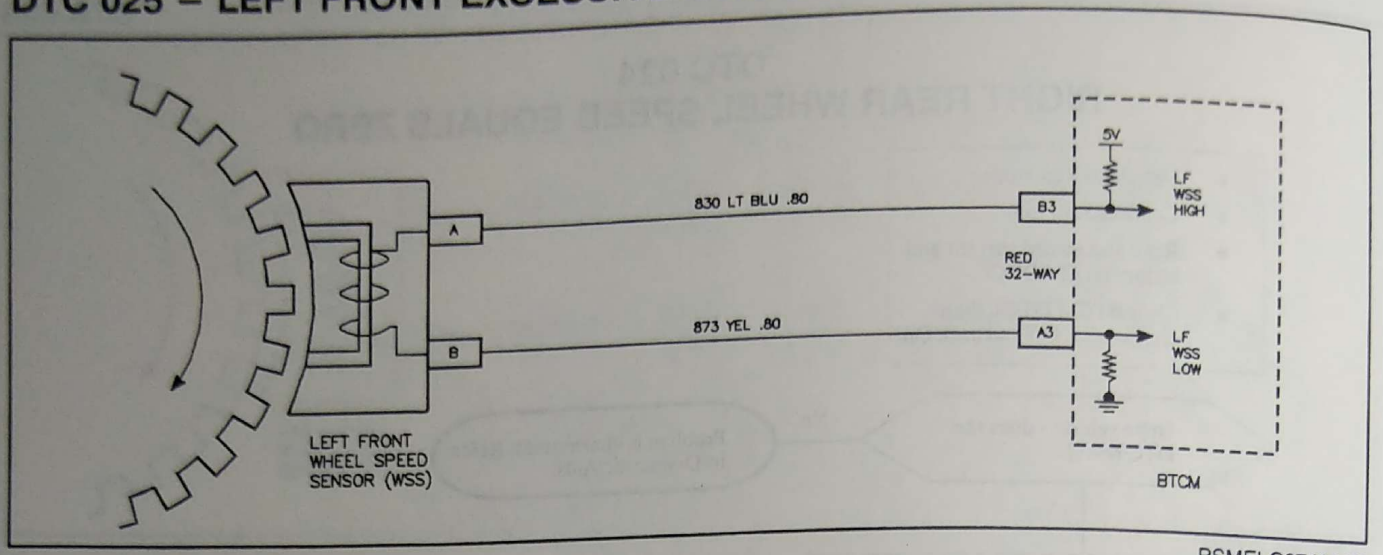
No → Is resistance steady and between 1250 and 2500 ohms while tapping on WSS?

No → Replace right rear WSS (part of rear hub/bearing assembly).

Yes → Replace BTCM.

CamScanner

DTC 025 – LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION



PSMELC67484AB

LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a wheel speed signal change greater than 16 km/h (10 mph) in eight milliseconds while the car is moving it will disable front ABS and the traction control system.

DTC PARAMETERS

DTC 025 will set if:

- Damaged tooth or teeth on wheel speed sensor ring.
- Loose sensor.
- Worn suspension/propulsion components.
- Intermittent short or open in the wheel speed circuit.
- Damaged connector.

DTC 025 will set when:

Braking is not requested and no left front wheel speed faults (DTCs 21, 31 or 32) are present. A fault exists if the left front wheel speed signal changes 16 km/h (10 mph) or more in eight milliseconds.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and the traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand and monitor the wheel speed. Make a comparison with other wheels.

The WSS may also be monitored while driving. Visually inspect sensors and connectors. Check the wheel speed sensor ring for tooth damage or out of round condition.

The WSS sensors are very sensitive to ring damage. Prying against the ring (with screwdrivers, etc.) will cause damage.

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

Using an ohmmeter to check resistance, shake wires to locate intermittents. For sensor resistance refer to the following chart:

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

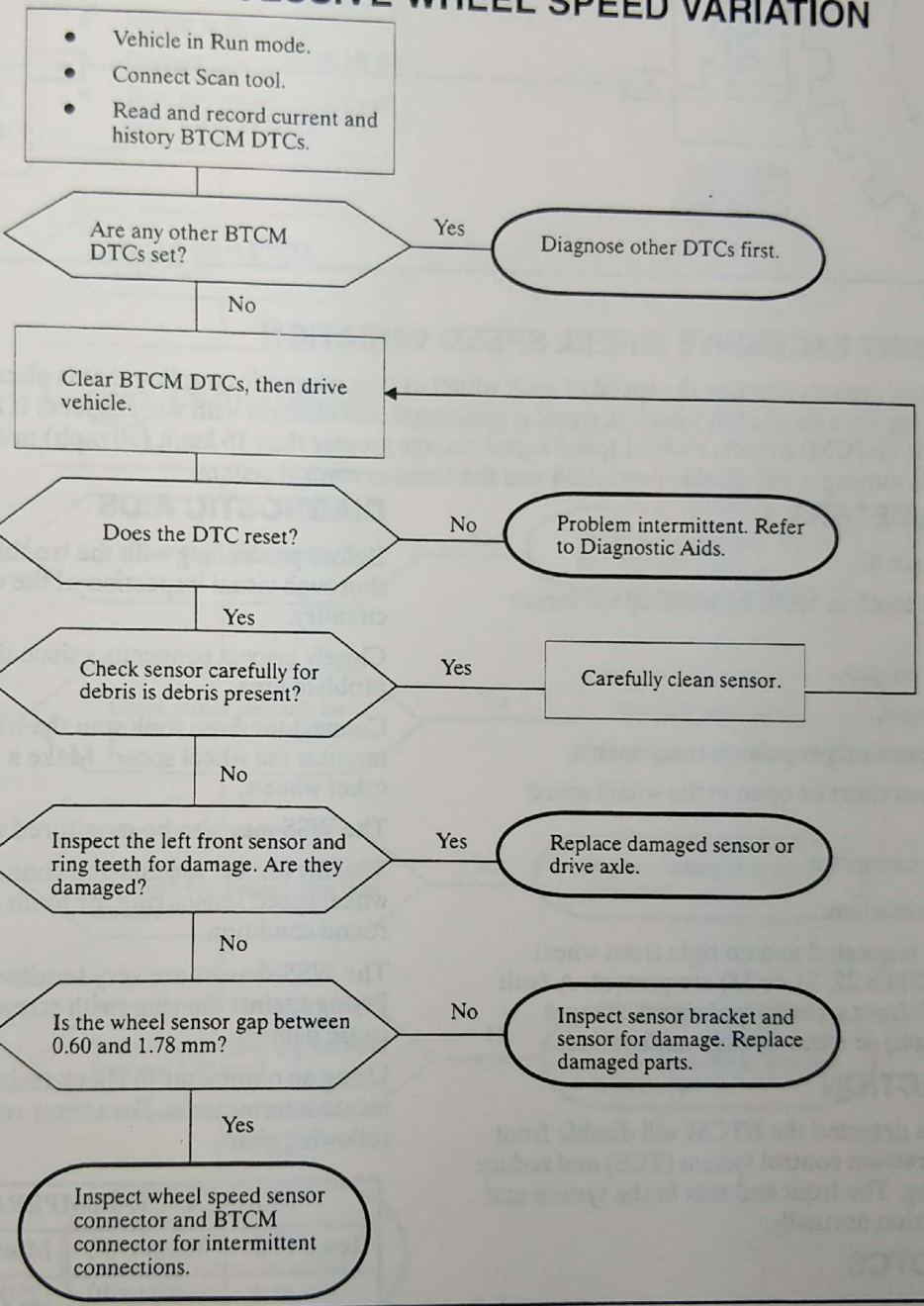
When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

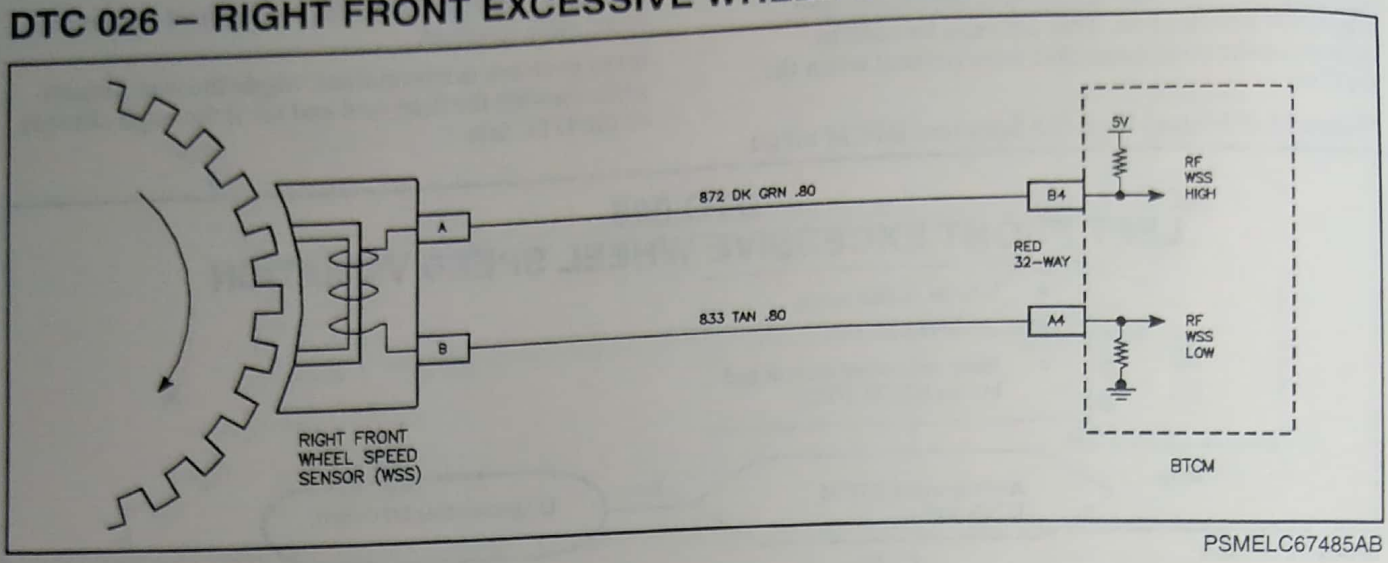
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent, wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 025
LEFT FRONT EXCESSIVE WHEEL SPEED VARIATION


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are any other BTCM DTCs set?
Yes
Diagnose other DTCs first.
No
Clear BTCM DTCs, then drive vehicle.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Check sensor carefully for debris is debris present?
Yes
Carefully clean sensor.
No
Inspect the left front sensor and ring teeth for damage. Are they damaged?
Yes
Replace damaged sensor or drive axle.
No
Is the wheel sensor gap between 0.60 and 1.78 mm?
No
Inspect sensor bracket and sensor for damage. Replace damaged parts.
Yes
Inspect wheel speed sensor connector and BTCM connector for intermittent connections.

DTC 026 – RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION



PSMELC67485AB

RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a wheel speed signal change greater than 16 km/h (10 mph) in eight milliseconds while the car is moving it will disable front ABS and the traction control system.

DTC PARAMETERS

DTC 026 will set if:

- Damaged tooth or teeth on wheel speed sensor ring.
- Incorrect air gap.
- Loose sensor.
- Worn suspension/propulsion components.
- Intermittent short or open in the wheel speed circuit.
- Damaged connector.

DTC 026 will set when:

Braking is not requested and no right front wheel speed faults (DTCs 22, 31 or 33) are present. A fault exists if the left front wheel speed signal changes 16 km/h (10 mph) or more in eight milliseconds.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and the traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree, make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand and monitor the wheel speed. Make a comparison with other wheels.

The WSS may also be monitored while driving.

Visually inspect sensors and connectors. Check the wheel speed sensor ring for tooth damage or out of round condition.

The WSS sensors are very sensitive to ring damage. Prying against the ring (with screwdrivers, etc.) will cause damage.

Using an ohmmeter to check resistance, shake wires to locate intermittents. For sensor resistance refer to the following chart:

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

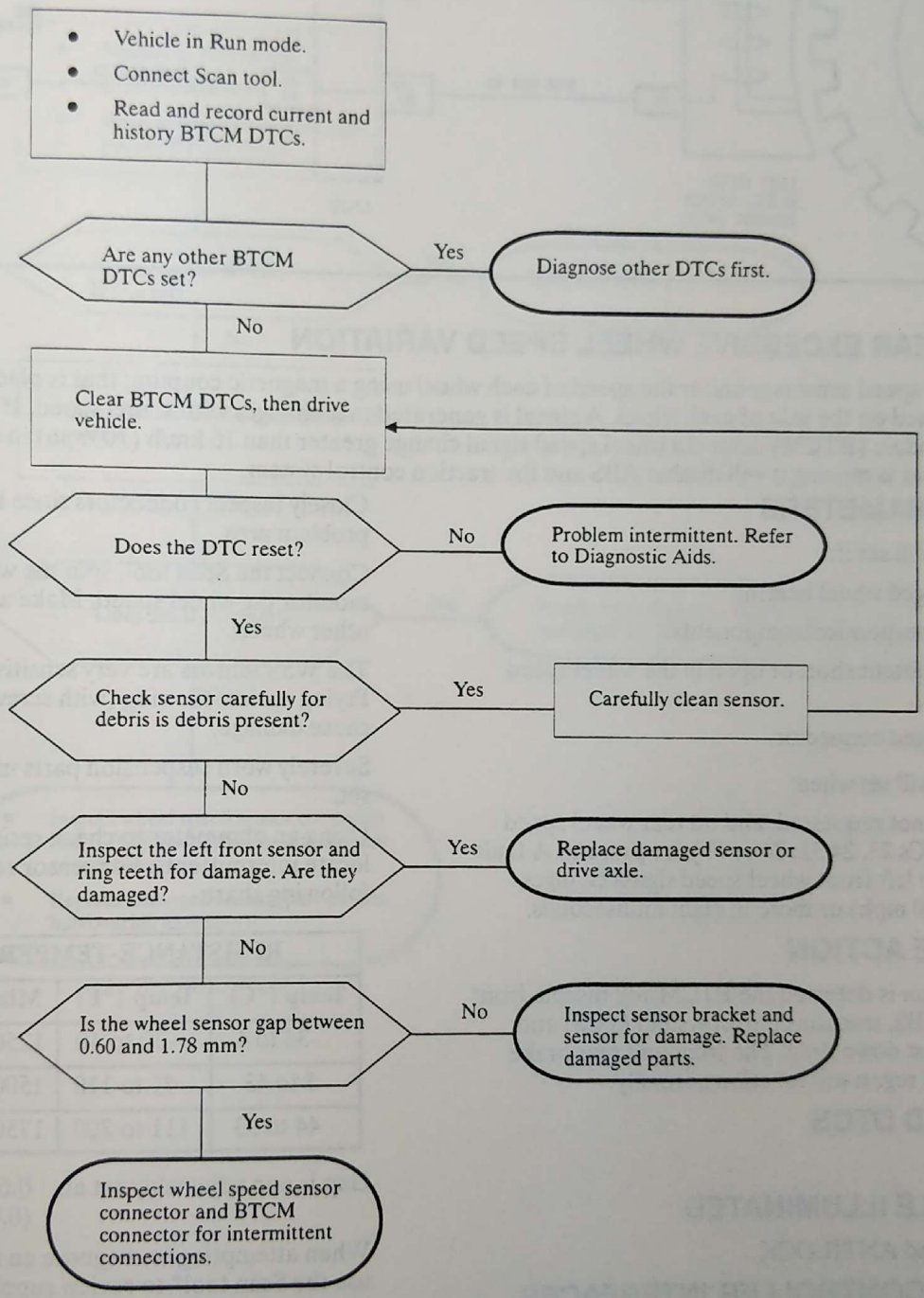
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

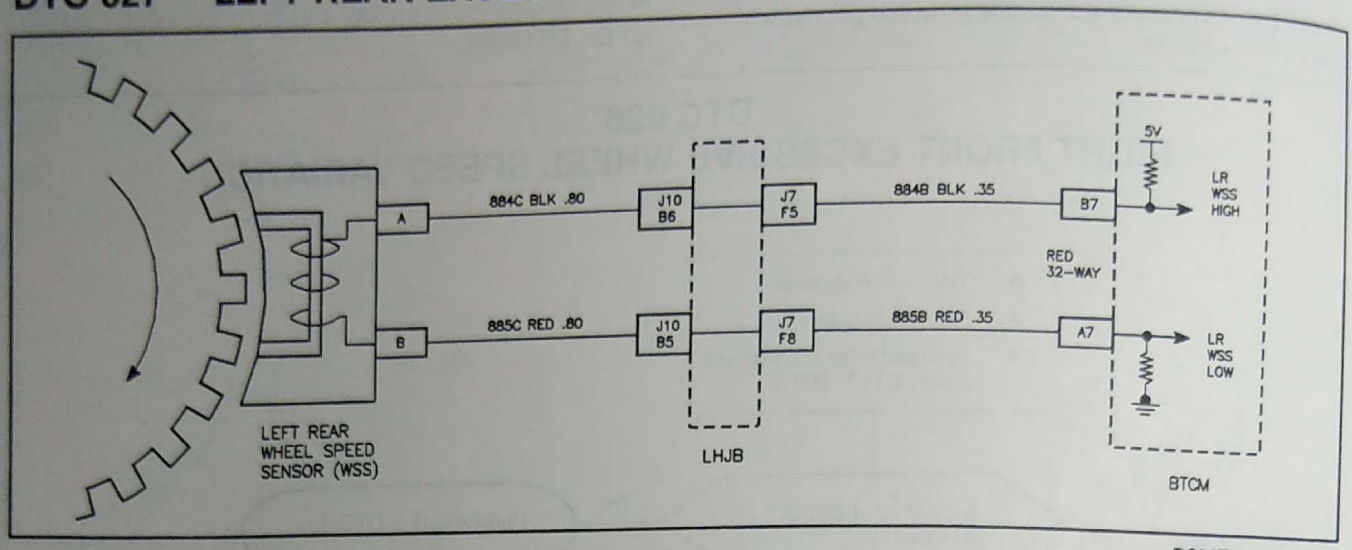
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent, wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 026
RIGHT FRONT EXCESSIVE WHEEL SPEED VARIATION


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are any other BTCM DTCs set?
Yes
Diagnose other DTCs first.
No
Clear BTCM DTCs, then drive vehicle.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Check sensor carefully for debris is debris present?
Yes
Carefully clean sensor.
No
Inspect the left front sensor and ring teeth for damage. Are they damaged?
Yes
Replace damaged sensor or drive axle.
No
Is the wheel sensor gap between 0.60 and 1.78 mm?
No
Inspect sensor bracket and sensor for damage. Replace damaged parts.
Yes
Inspect wheel speed sensor connector and BTCM connector for intermittent connections.

DTC 027 – LEFT REAR EXCESSIVE WHEEL SPEED VARIATION



PSMELC67486AB

LEFT REAR EXCESSIVE WHEEL SPEED VARIATION

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a wheel speed signal change greater than 16 km/h (10 mph) in eight milliseconds while the car is moving it will disable ABS and the traction control system.

DTC PARAMETERS

DTC 027 will set if:

- Damaged wheel bearing
- Worn suspension components.
- Intermittent short or open in the wheel speed circuit.
- Damaged connector.

DTC 027 will set when:

Braking is not requested, and no rear wheel speed faults (DTCs 23, 24,31, 34 or 35) are present. A fault exists if the left front wheel speed signal changes 16 km/h (10 mph) or more in eight milliseconds.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS, traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand and monitor the wheel speed. Make a comparison with other wheels.

The WSS sensors are very sensitive to ring damage. Prying against the ring (with screwdrivers, etc.) will cause damage.

Severely worn suspension parts may cause this DTC to set.

Using an ohmmeter to check resistance, shake wires to locate intermittents. For sensor resistance refer to the following chart:

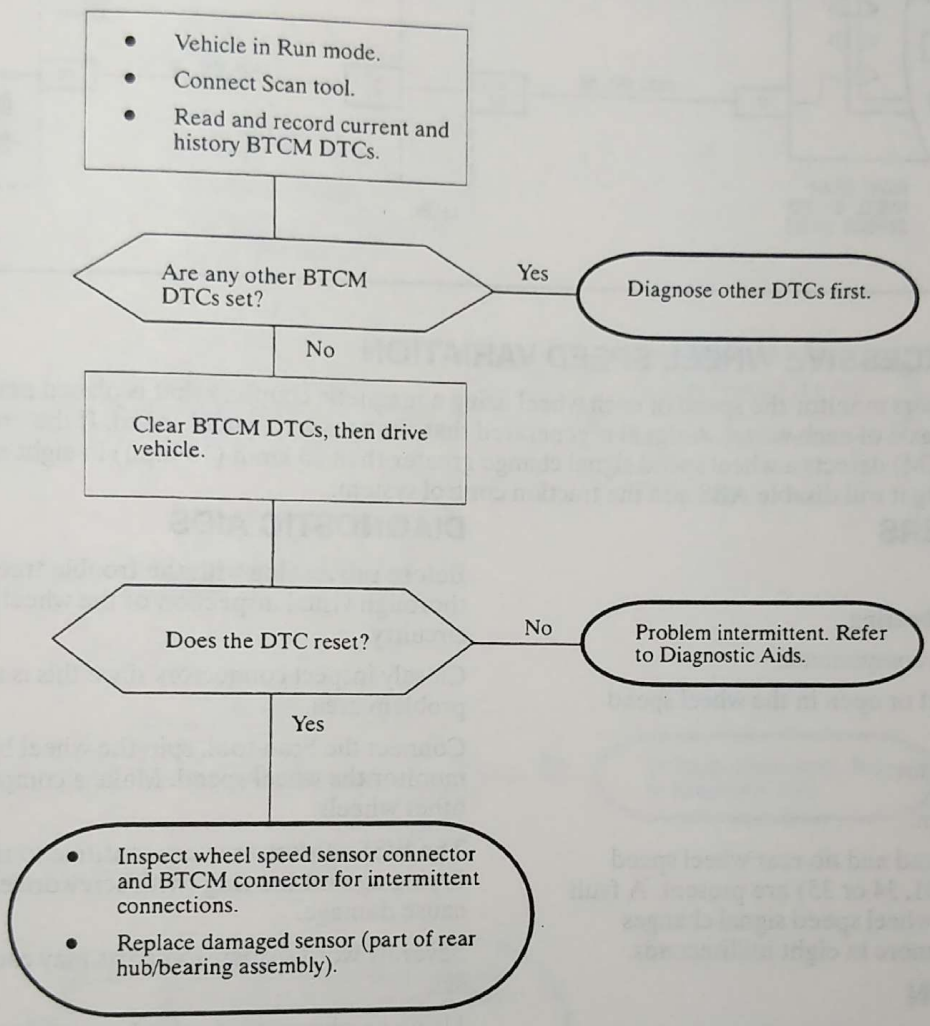
RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

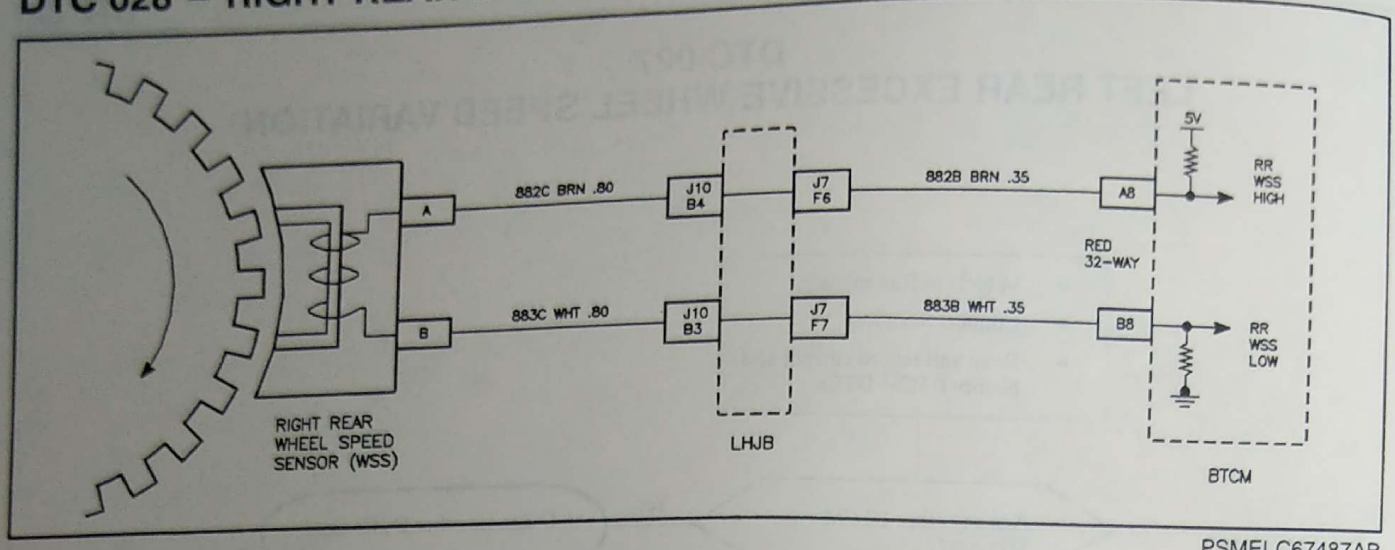
When attempting to diagnose an intermittent problem, use the Scan tool* to review supplemental diagnostic information. The supplemental data can be used to duplicate conditions that were present when a problem occurred.

*Select Malf History from the Scan tool BTCM menu.

DTC 027
LEFT REAR EXCESSIVE WHEEL SPEED VARIATION


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are any other BTCM DTCs set?
Yes
Diagnose other DTCs first.
No
Clear BTCM DTCs, then drive vehicle.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Inspect wheel speed sensor connector and BTCM connector for intermittent connections.
Replace damaged sensor (part of rear hub/bearing assembly).

DTC 028 – RIGHT REAR EXCESSIVE WHEEL SPEED VARIATION



PSMELC67487AB

RIGHT REAR EXCESSIVE WHEEL SPEED VARIATION

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a wheel speed signal change greater than 16 km/h (10 mph) in eight milliseconds while the car is moving it will disable ABS and the traction control system.

DTC PARAMETERS

DTC 028 will set if:

- Damaged wheel bearing.
- Worn suspension components.
- Intermittent short or open in the wheel speed circuit.
- Damaged connector.

DTC 028 will set when:

Braking is not requested and no rear wheel speed faults (DTCs 23, 24, 31, 34 or 35) are present. A fault exists if the left front wheel speed signal changes 16 km/h (10 mph) or more in eight milliseconds.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS, traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree, make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

Connect the Scan tool, spin the wheel by hand and monitor the wheel speed. Make a comparison with other wheels.

The WSS sensors are very sensitive to ring damage. Prying against the ring (with screwdrivers, etc.) will cause damage.

Severely worn suspension parts may cause this DTC to set.

Using an ohmmeter to check resistance, shake wires to locate intermittents. For sensor resistance refer to the following chart:

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

Gap is non adjustably set at: 0.60 – 1.78 mm (0.025 – 0.070 in.)

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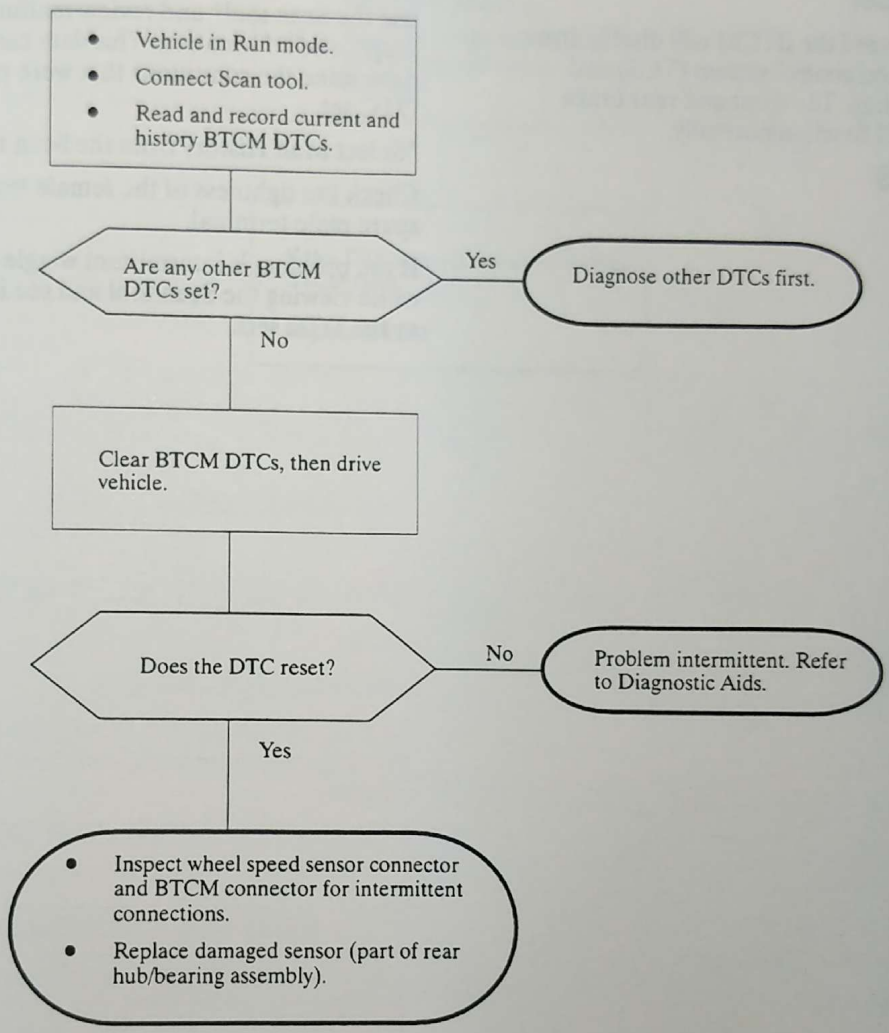
When attempting to diagnose an intermittent problem, use the Scan tool* to review supplemental diagnostic information. The supplemental data can be used to duplicate conditions that were present when a problem occurred.
*Select Malf History from the Scan tool BTCM menu.

DTC 028
RIGHT REAR EXCESSIVE WHEEL SPEED VARIATION


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are any other BTCM DTCs set?
Yes
Diagnose other DTCs first.
No
Clear BTCM DTCs, then drive vehicle.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Inspect wheel speed sensor connector and BTCM connector for intermittent connections.
Replace damaged sensor (part of rear hub/bearing assembly).

DTC 031 – WHEEL SPEED SENSOR INTERFACE CHIP FAULT

If the brake torque control module (BTCM) detects a fault with the WSS interface chip it will disable front and rear ABS, rear braking and the traction control system.

DTC PARAMETERS

DTC 031 will set if:

The wheel speed sensor interface chip has failed.

DTC 031 will set when:

Anytime Run 1 is present.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS, traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 031
WHEEL SPEED SENSOR INTERFACE CHIP FAULT

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

If this DTC sets it is due to an internal BTCM fault.

Replace BTCM

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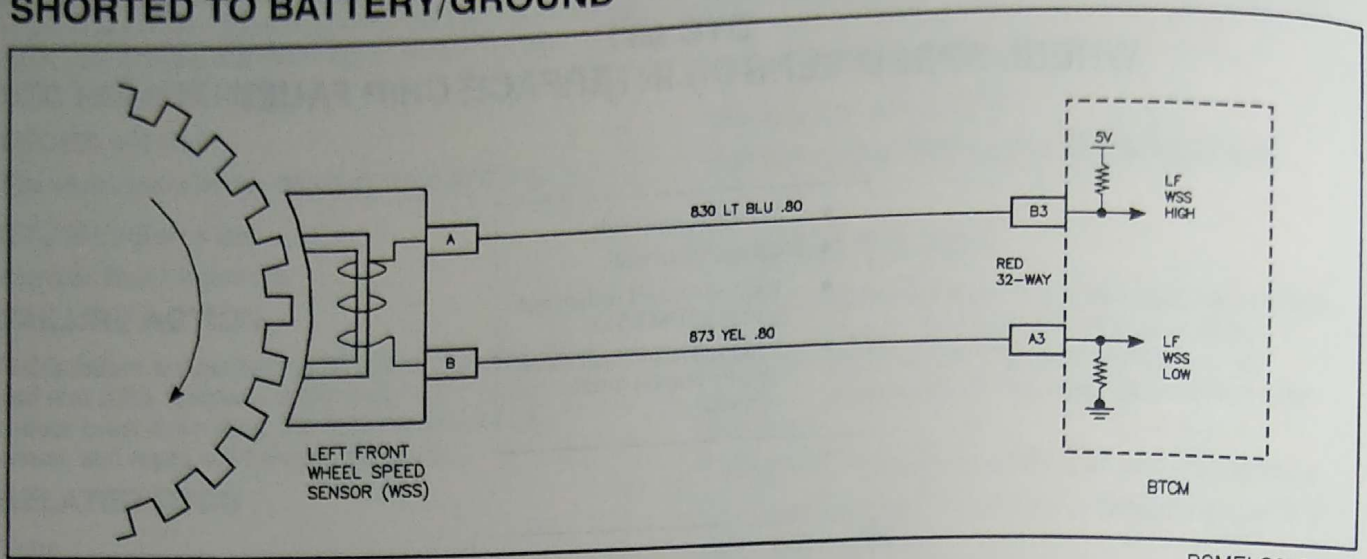
DTC 032 – LEFT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND



PSMELC67484AB

LEFT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a front wheel speed circuit fault it will disable front ABS and the traction control system.

DTC PARAMETERS

DTC 032 will set if:

- One or both WSS input wires open or shorted to battery or ground.
- Left front WSS open or shorted to battery/ground.
- Left front WSS resistance high.

DTC 032 will set when:

This fault can be set anytime Run 1 is present. A short to battery fault will occur if the High and Low inputs are greater than 3.3 volts. A short to ground fault will occur if the High and Low inputs are less than 1.7 volts. An open fault will occur if the High input is greater than 3.3 volts AND the low input is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and the traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree, make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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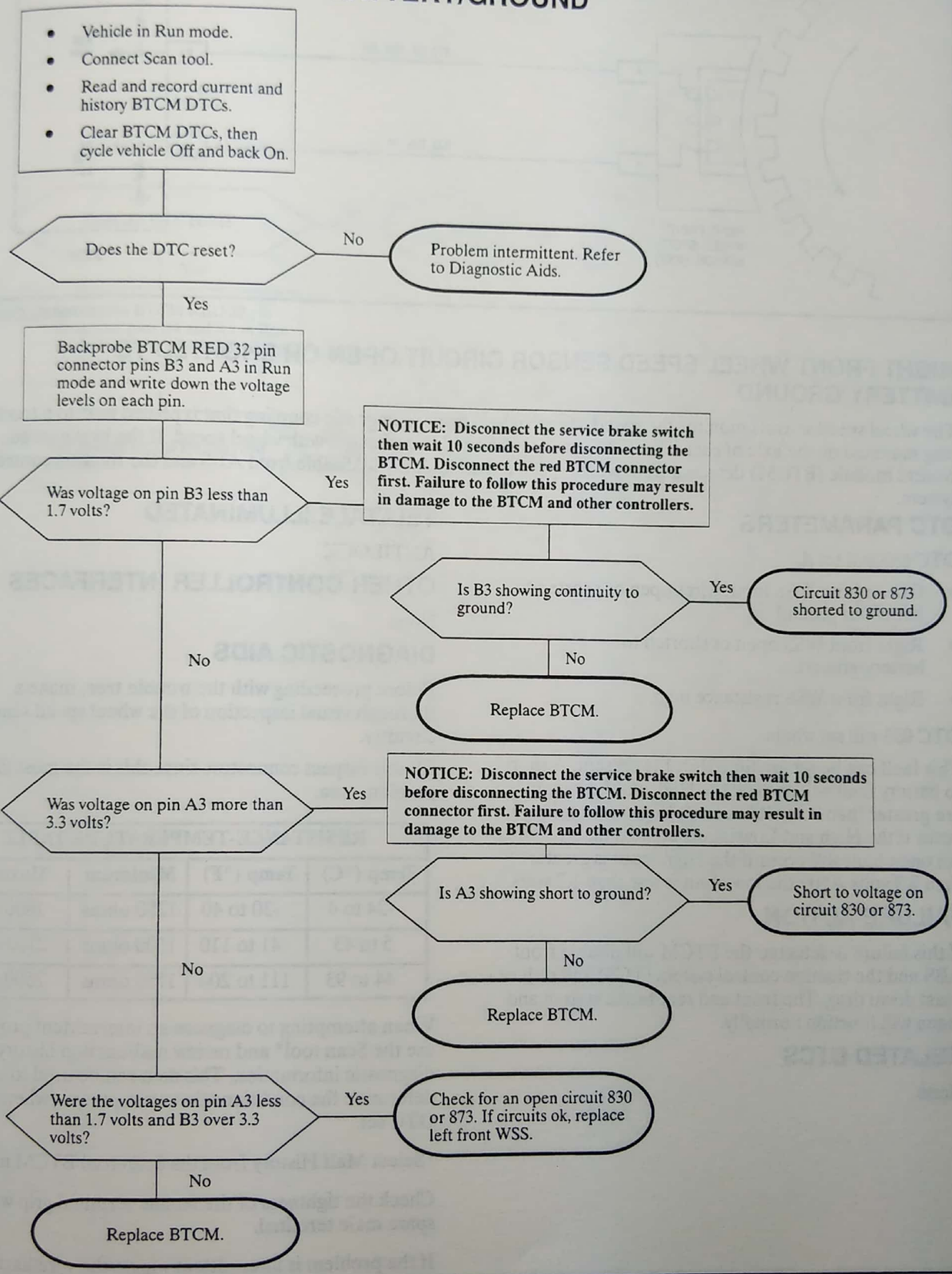
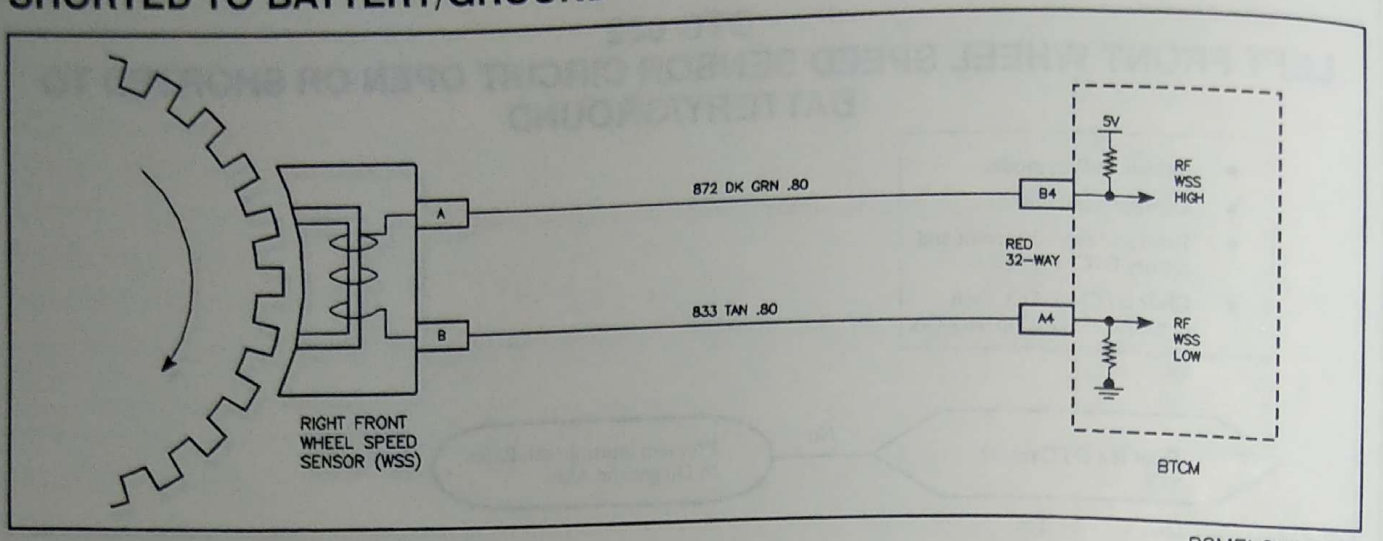
DTC 032
LEFT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Backprobe BTCM RED 32 pin connector pins B3 and A3 in Run mode and write down the voltage levels on each pin.
Was voltage on pin B3 less than 1.7 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is B3 showing continuity to ground?
Yes
Circuit 830 or 873 shorted to ground.
No
Replace BTCM.
No
Was voltage on pin A3 more than 3.3 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is A3 showing short to ground?
Yes
Short to voltage on circuit 830 or 873.
No
Replace BTCM.
No
Were the voltages on pin A3 less than 1.7 volts and B3 over 3.3 volts?
Yes
Check for an open circuit 830 or 873. If circuits ok, replace left front WSS.
No
Replace BTCM.

DTC 033 – RIGHT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND



PSMELC67485AB

RIGHT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a front wheel speed circuit fault it will disable front ABS and the traction control system.

DTC PARAMETERS

DTC 033 will set if:

- One or both WSS input wires open or shorted to battery or ground.
- Right front WSS open or shorted to battery/ground.
- Right front WSS resistance high.

DTC 033 will set when:

This fault can be set anytime Run 1 is present. A short to battery fault will occur if the High and Low inputs are greater than 3.3 volts. A short to ground fault will occur if the High and Low inputs are less than 1.7 volts. An open fault will occur if the High input is greater than 3.3 volts AND the low input is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and the traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree, make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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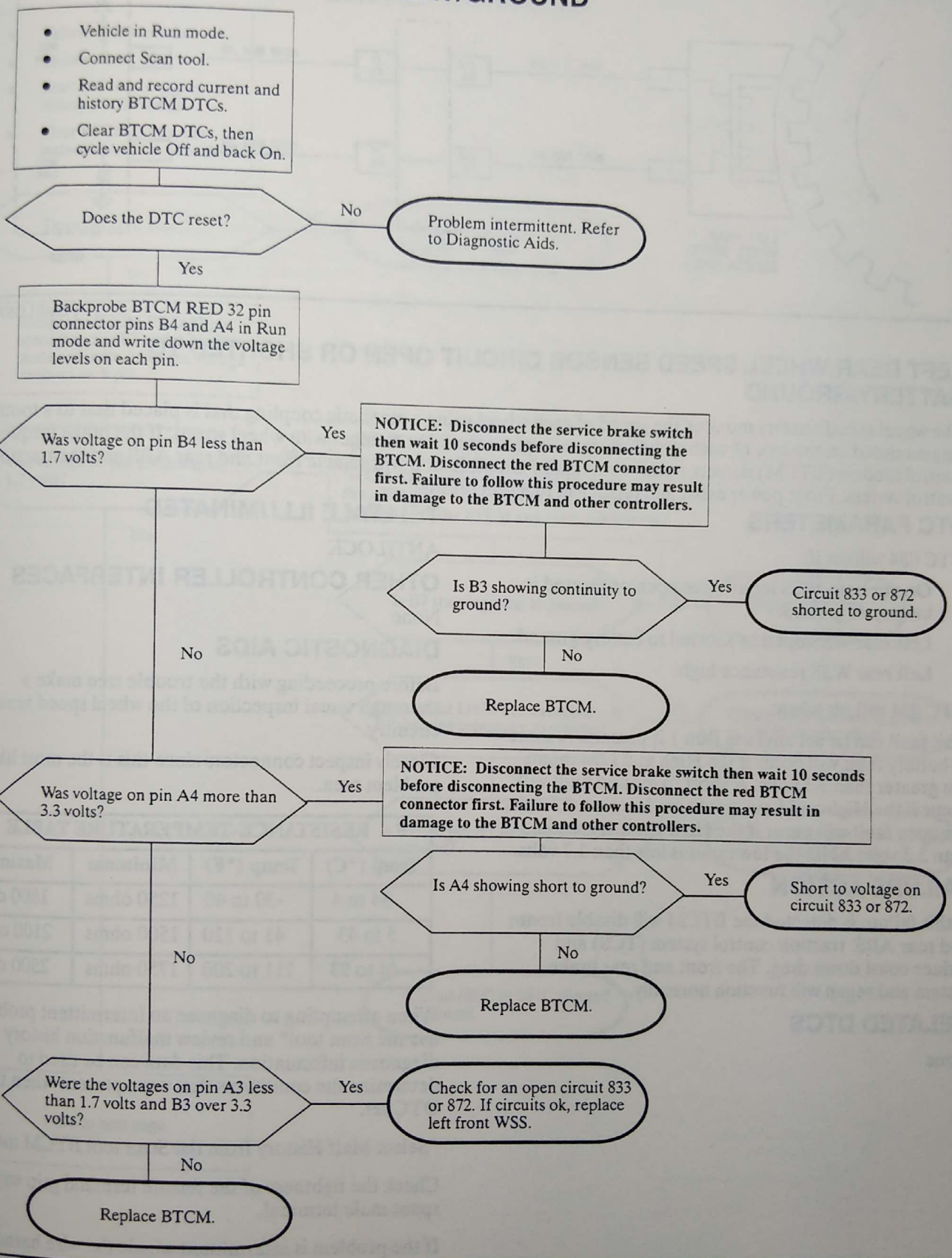
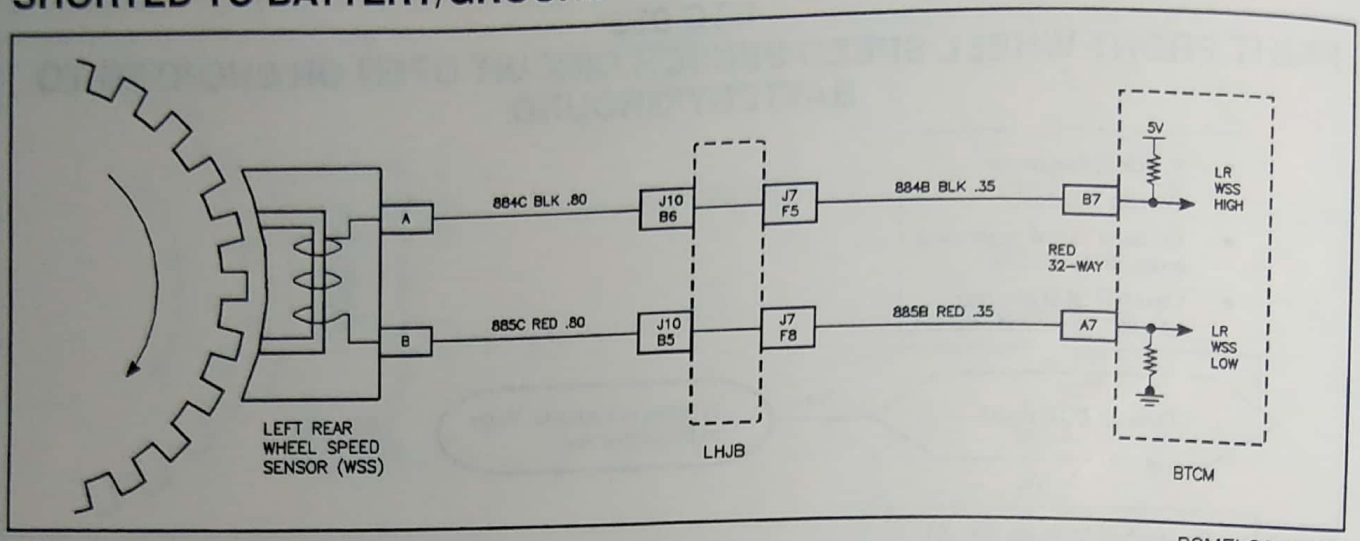
DTC 033
RIGHT FRONT WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Backprobe BTCM RED 32 pin connector pins B4 and A4 in Run mode and write down the voltage levels on each pin.
Was voltage on pin B4 less than 1.7 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is B3 showing continuity to ground?
Yes
Circuit 833 or 872 shorted to ground.
No
No
Replace BTCM.
Was voltage on pin A4 more than 3.3 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is A4 showing short to ground?
Yes
Short to voltage on circuit 833 or 872.
No
No
Replace BTCM.
Were the voltages on pin A3 less than 1.7 volts and B3 over 3.3 volts?
Yes
Check for an open circuit 833 or 872. If circuits ok, replace left front WSS.
No
Replace BTCM.

DTC 034 – LEFT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND



PSMELC67486AB

LEFT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake torque control module (BTCM) detects a rear wheel speed circuit fault it will disable front and rear ABS and the traction control system. Front power assist and regen will function normally.

DTC PARAMETERS

DTC 034 will set if:

- One or both WSS input wires open or shorted to battery or ground.
- Left rear WSS open or shorted to battery/ground.
- Left rear WSS resistance high.

DTC 034 will set when:

This fault can be set anytime Run 1 is present. A short to battery fault will occur if the High and Low inputs are greater than 3.3 volts. A short to ground fault will occur if the High and Low inputs are less than 1.7 volts. An open fault will occur if the High input is greater than 3.3 volts AND the low input is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS, traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

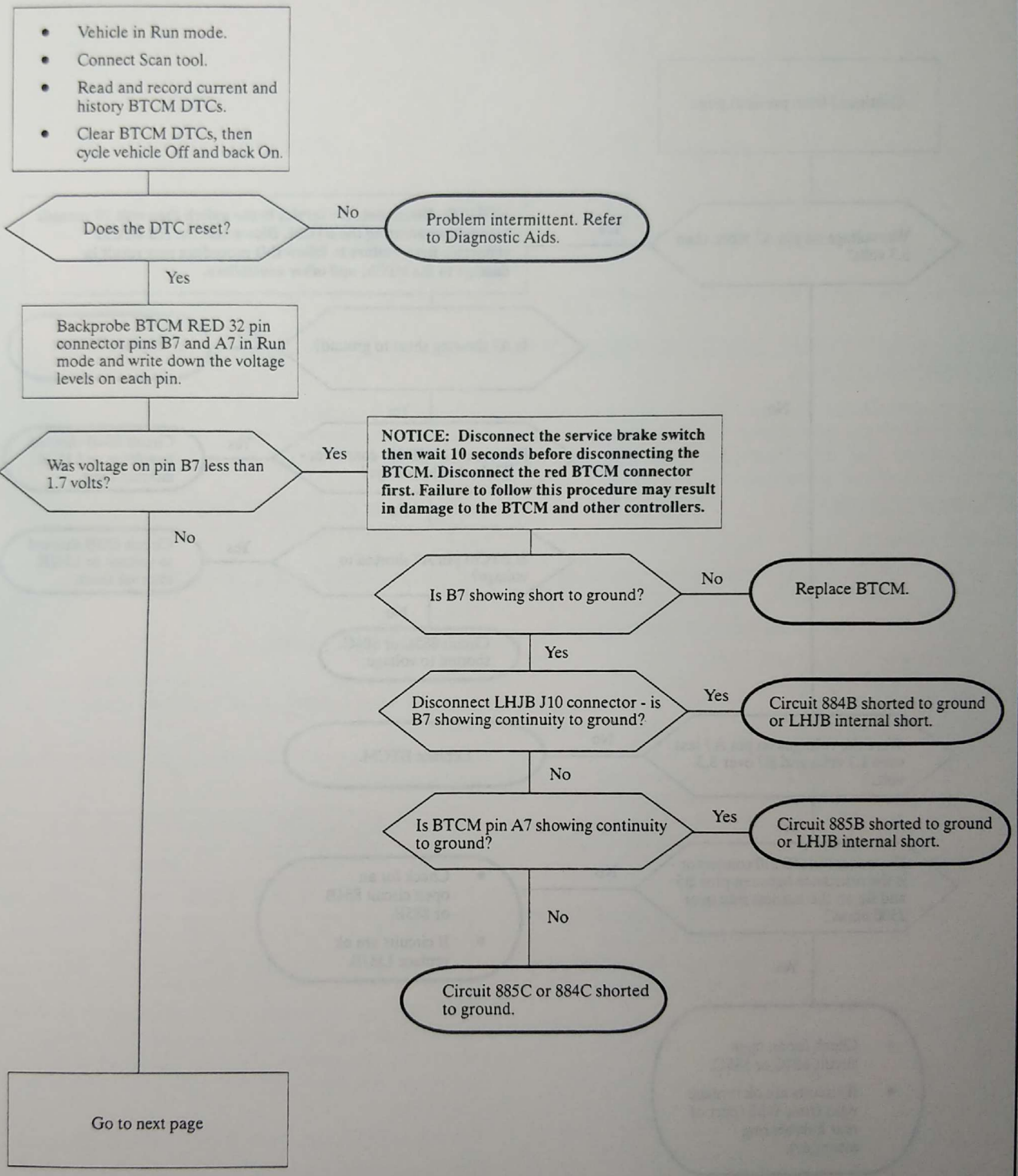
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

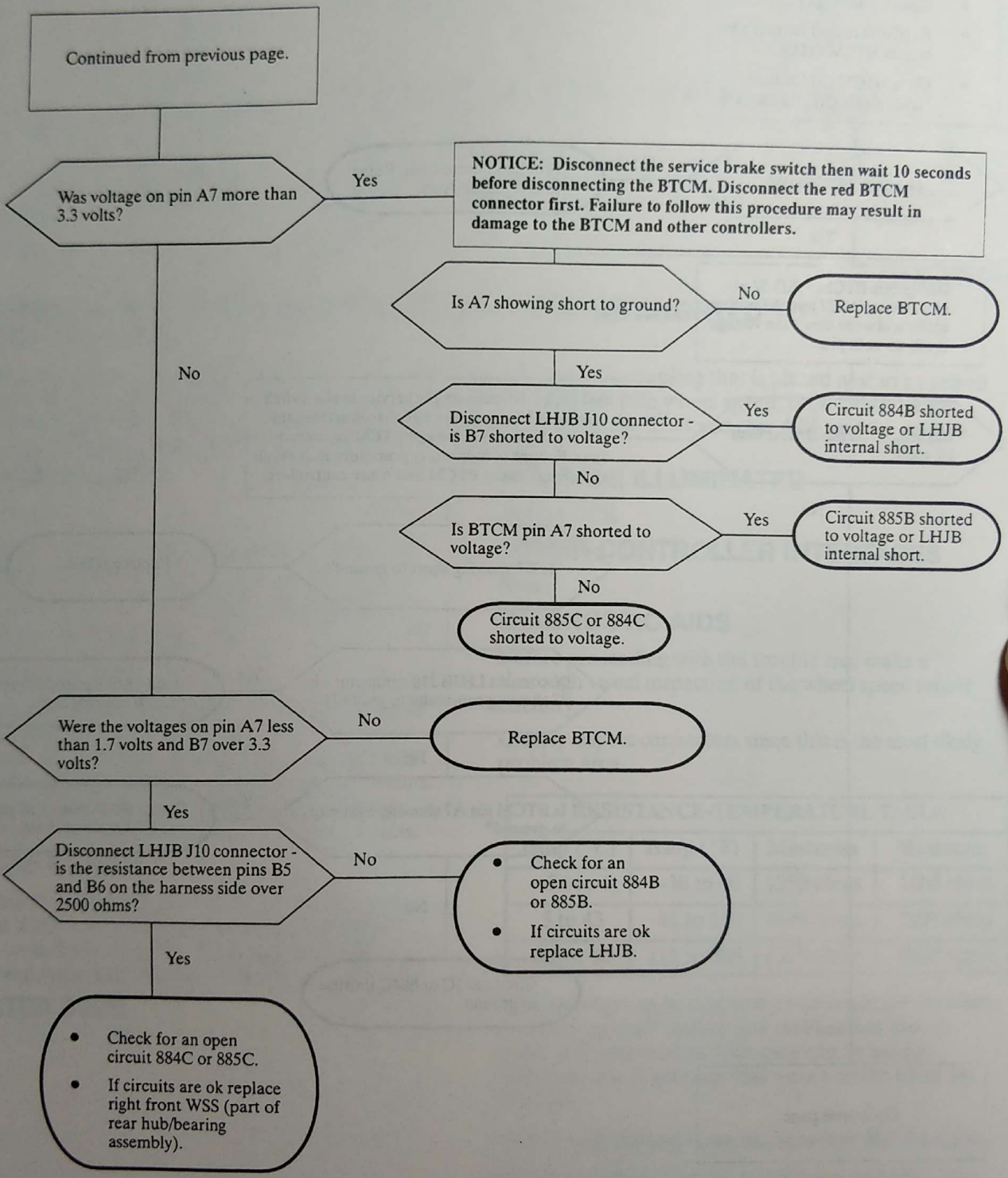
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 034
LEFT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Backprobe BTCM RED 32 pin connector pins B7 and A7 in Run mode and write down the voltage levels on each pin.
Was voltage on pin B7 less than 1.7 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
No
Is B7 showing short to ground?
No
Replace BTCM.
Yes
Disconnect LHJB J10 connector - is B7 showing continuity to ground?
Yes
Circuit 884B shorted to ground or LHJB internal short.
No
Is BTCM pin A7 showing continuity to ground?
Yes
Circuit 885B shorted to ground or LHJB internal short.
No
Circuit 885C or 884C shorted to ground.
Go to next page

DTC 034
LEFT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND – CONTINUED


Continued from previous page.
Was voltage on pin A7 more than 3.3 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is A7 showing short to ground?
No
Replace BTCM.
Yes
Disconnect LHJB J10 connector - is B7 shorted to voltage?
Yes
Circuit 884B shorted to voltage or LHJB internal short.
No
Is BTCM pin A7 shorted to voltage?
Yes
Circuit 885B shorted to voltage or LHJB internal short.
No
Circuit 885C or 884C shorted to voltage.
No
Were the voltages on pin A7 less than 1.7 volts and B7 over 3.3 volts?
No
Replace BTCM.
Yes
Disconnect LHJB J10 connector - is the resistance between pins B5 and B6 on the harness side over 2500 ohms?
No
• Check for an open circuit 884B or 885B.
• If circuits are ok replace LHJB.
Yes
• Check for an open circuit 884C or 885C.
• If circuits are ok replace right front WSS (part of rear hub/bearing assembly).

NOTES

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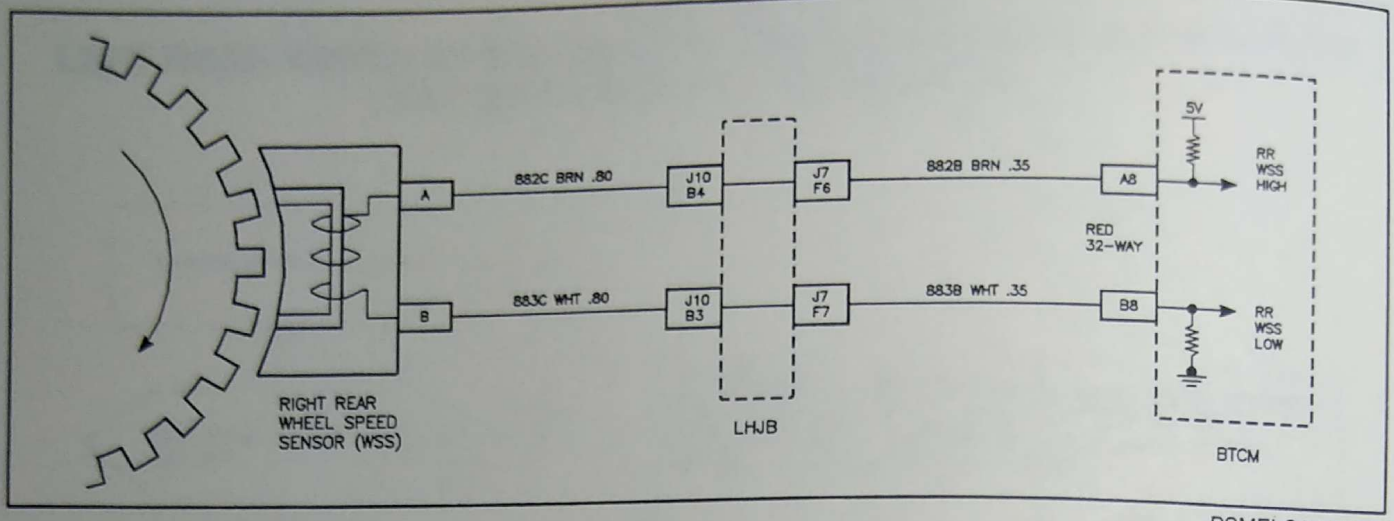
DTC 035 – RIGHT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND



PSMELC67487AB

RIGHT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND

The wheel speed sensors monitor the speed of each wheel using a magnetic coupling that is placed next to a toothed ring mounted on the axle of each wheel. A signal is generated that changes with wheel speed. If the brake traction control module (BTCM) detects a rear wheel speed circuit fault it will disable front and rear ABS and the traction control system. Front power assist and regen will function normally.

DTC PARAMETERS

DTC 035 will set if:

- One or both WSS input wires open or shorted to battery or ground.
- Right rear WSS open or shorted to battery/ground.
- Right rear WSS resistance high.

DTC 035 will set when:

This fault can be set anytime Run 1 is present. A short to battery fault will occur if the High and Low inputs are greater than 3.3 volts. A short to ground fault will occur if the High and Low inputs are less than 1.7 volts. An open fault will occur if the High input is greater than 3.3 volts AND the low input is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS, traction control system (TCS) and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

Before proceeding with the trouble tree make a thorough visual inspection of the wheel speed sensor circuitry.

Closely inspect connectors since this is the most likely problem area.

RESISTANCE-TEMPERATURE TABLE			
Temp (°C)	**Temp (°F)**	**Minimum**	**Maximum**
-34 to 4	-30 to 40	1250 ohms	1800 ohms
5 to 43	41 to 110	1500 ohms	2100 ohms
44 to 93	111 to 200	1750 ohms	2500 ohms

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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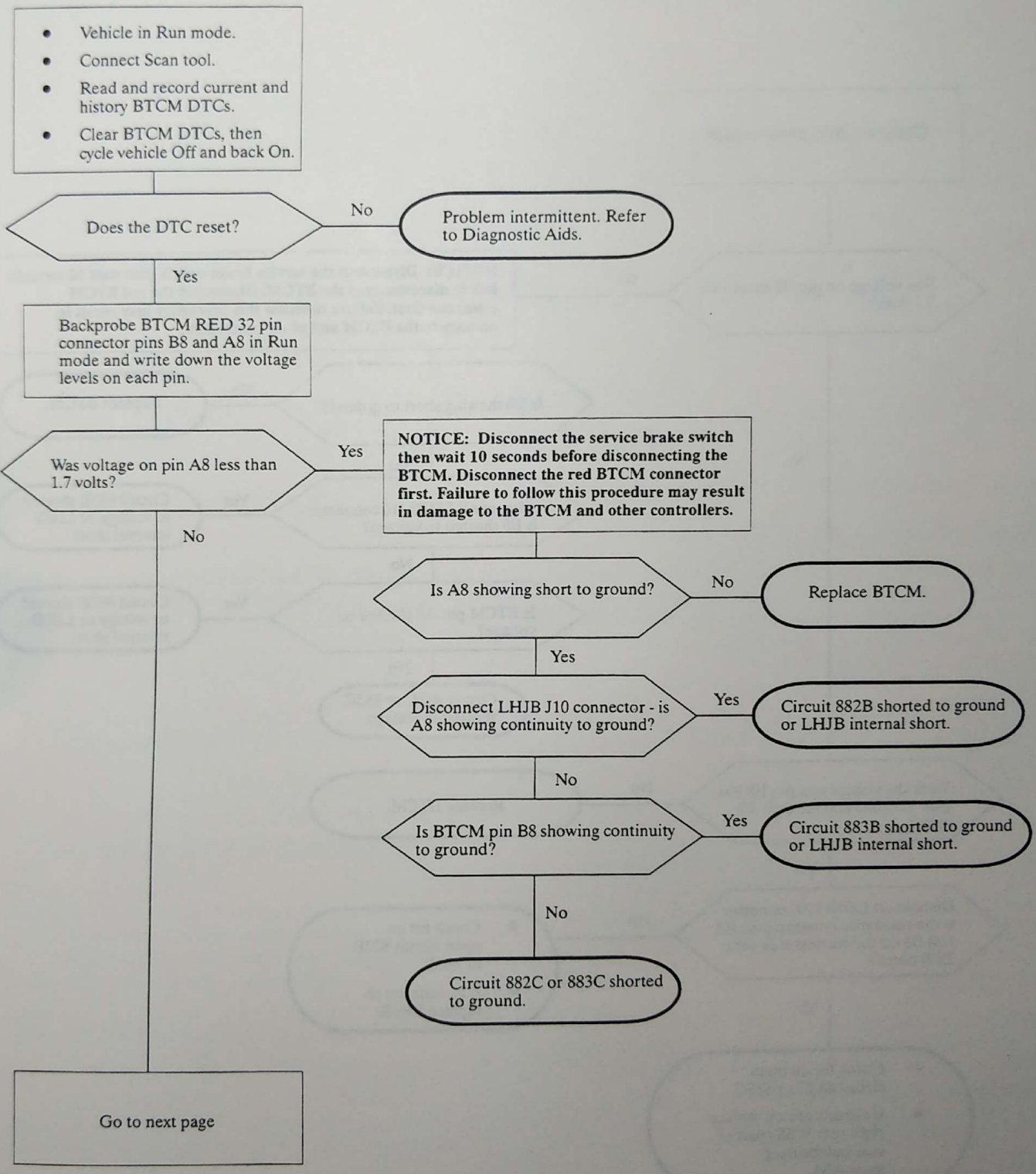
DTC 035
RIGHT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
Backprobe BTCM RED 32 pin connector pins B8 and A8 in Run mode and write down the voltage levels on each pin.
Was voltage on pin A8 less than 1.7 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
No
Is A8 showing short to ground?
No
Replace BTCM.
Yes
Disconnect LHJB J10 connector - is A8 showing continuity to ground?
Yes
Circuit 882B shorted to ground or LHJB internal short.
No
Is BTCM pin B8 showing continuity to ground?
Yes
Circuit 883B shorted to ground or LHJB internal short.
No
Circuit 882C or 883C shorted to ground.
Go to next page

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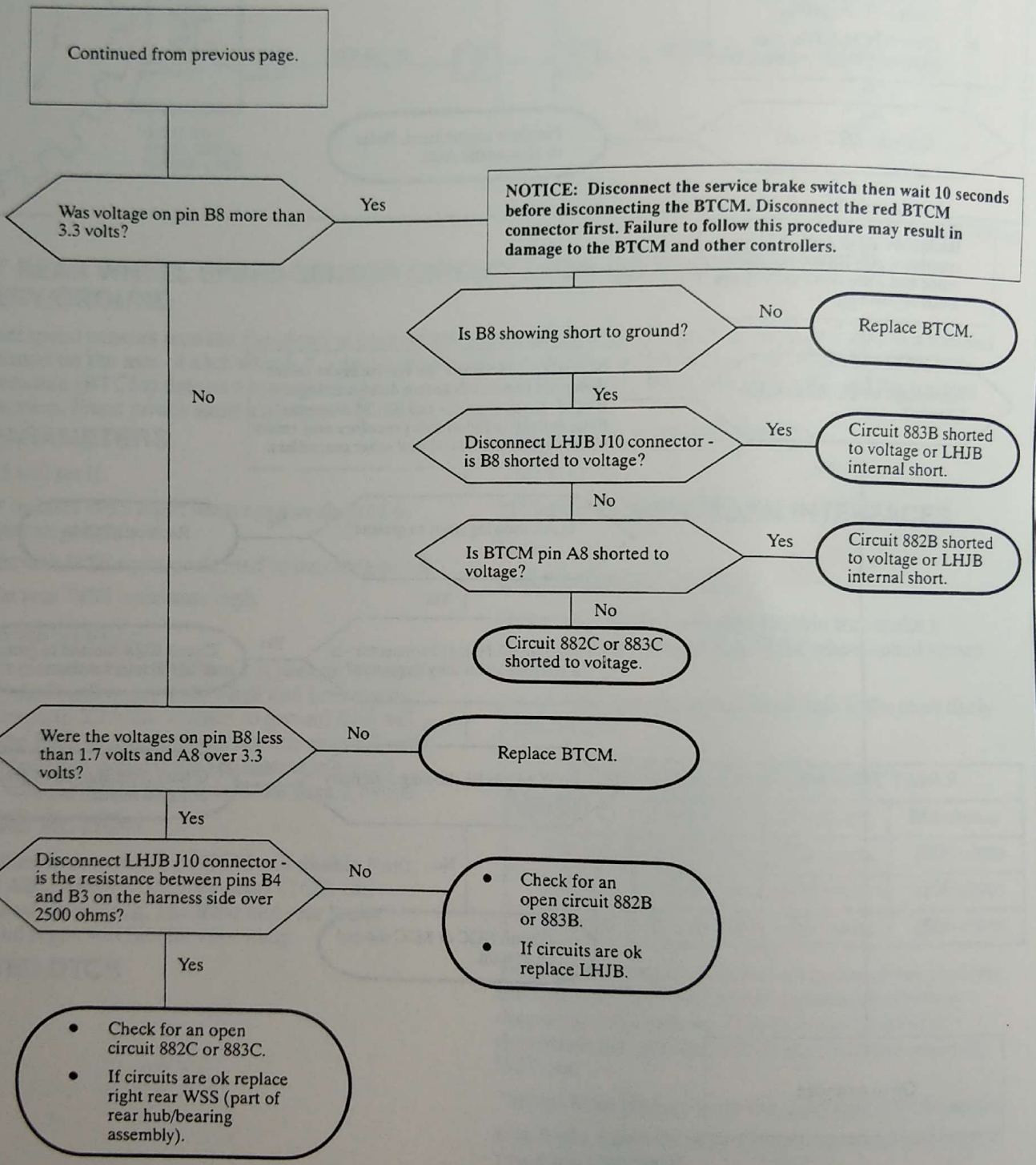
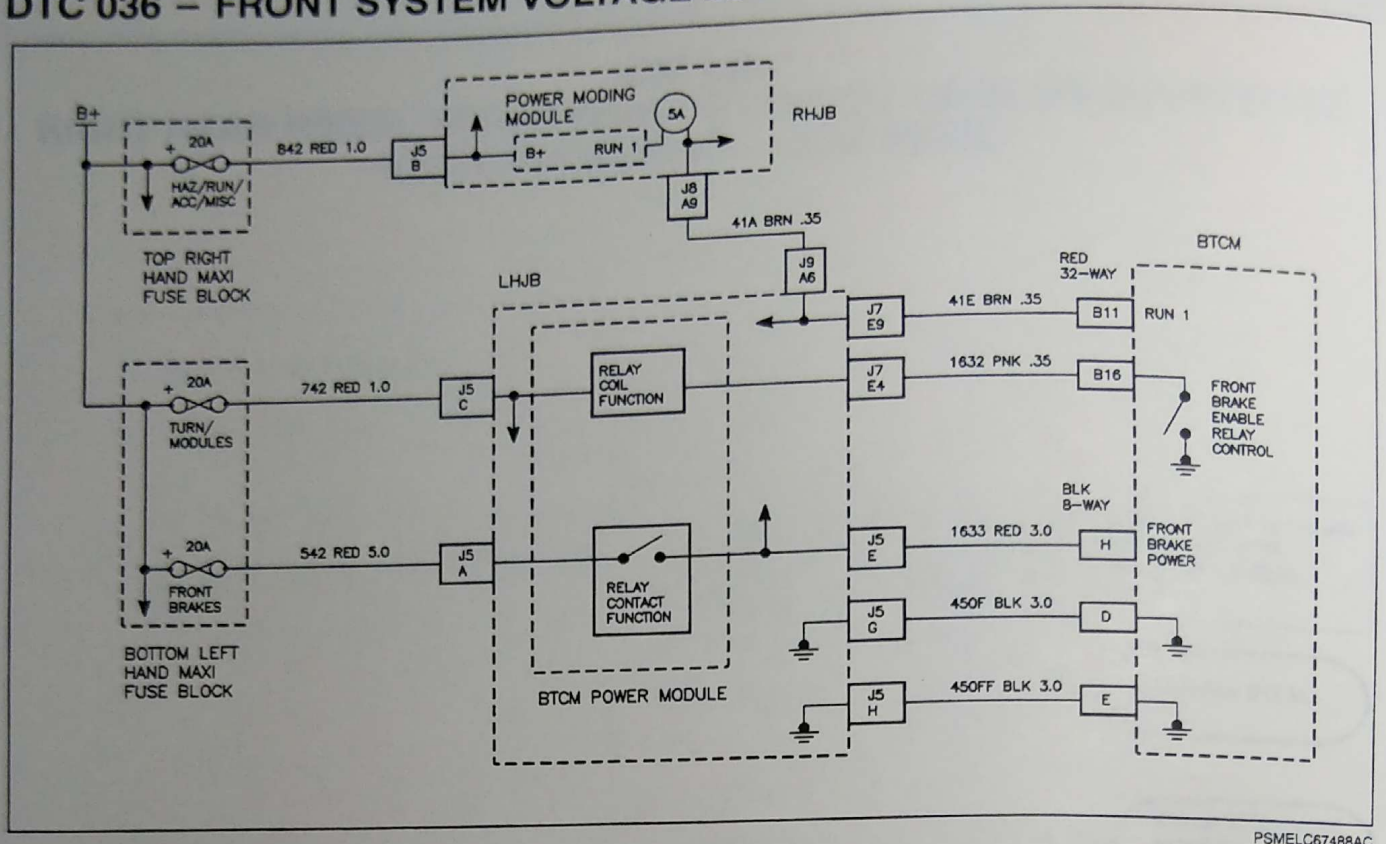
DTC 035
RIGHT REAR WHEEL SPEED SENSOR CIRCUIT OPEN OR SHORTED TO BATTERY/GROUND – CONTINUED


Continued from previous page.
Was voltage on pin B8 more than 3.3 volts?
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is B8 showing short to ground?
No
Replace BTCM.
Yes
Disconnect LHJB J10 connector - is B8 shorted to voltage?
Yes
Circuit 883B shorted to voltage or LHJB internal short.
No
Is BTCM pin A8 shorted to voltage?
Yes
Circuit 882B shorted to voltage or LHJB internal short.
No
Circuit 882C or 883C shorted to voltage.
No
Were the voltages on pin B8 less than 1.7 volts and A8 over 3.3 volts?
No
Replace BTCM.
Yes
Disconnect LHJB J10 connector - is the resistance between pins B4 and B3 on the harness side over 2500 ohms?
No
• Check for an open circuit 882B or 883B.
• If circuits are ok replace LHJB.
Yes
• Check for an open circuit 882C or 883C.
• If circuits are ok replace right rear WSS (part of rear hub/bearing assembly).

NOTES

CamScanner

DTC 036 – FRONT SYSTEM VOLTAGE LOW



PSMELC67488AC

FRONT SYSTEM VOLTAGE LOW

The brake torque control module (BTCM) receives switched battery voltage for the front braking system when the solid state front enable relay contact circuit is closed. This input provides voltage and current to power the front motors, solenoids and electromagnetic brakes (EMBs). If the BTCM detects a fault in this circuit it will disable ABS and the front power assist base brakes.

DTC PARAMETERS

DTC 036 will set if:

- Malfunctioning accessory AC and DC power module (APM).
- Faulty auxiliary battery.

DTC 036 will set when:

This fault can be set anytime the BTCM is awake and Run 1 is not present. A front voltage low fault will occur if the run voltage is less than 4.9 volts and the front system voltage is less than 8.9 volts, and the brakes are active.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 036
FRONT SYSTEM VOLTAGE LOW

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.
- Clear BTCM DTCs, then cycle vehicle OFF, then back ON.

Does the DTC reset?

No → Problem intermittent. Refer to Diagnostic Aids.

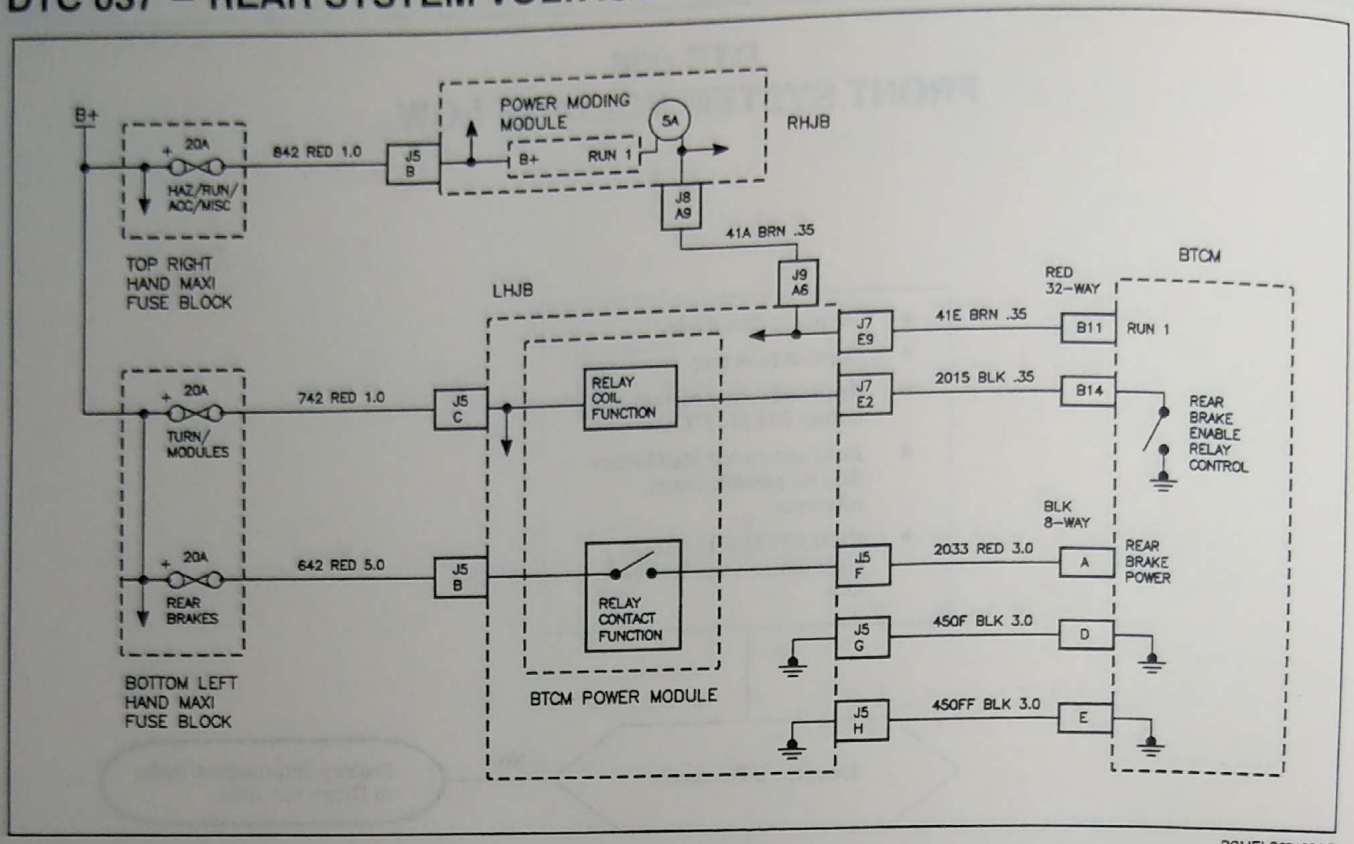
Yes

Current DTC 36 will not set in any known failure conditions.

If DTC 36 is set contact Technical Assistance.

CamScanner

DTC 037 – REAR SYSTEM VOLTAGE LOW



PSMELC67489AC

REAR SYSTEM VOLTAGE LOW

The brake torque control module (BTCM) receives switched battery voltage for the rear braking system when the solid state rear enable relay contact circuit is closed. This input provides voltage and current to power the rear motors. If the BTCM detects a fault in this circuit it will disable front and rear ABS.

DTC PARAMETERS

DTC 037 will set if:

- Malfunctioning accessory AC and DC power module (APM).
- Faulty auxiliary battery.
- Ground circuit resistance high.

DTC 037 will set when:

This fault can be set anytime Run 1 is present. A rear voltage low fault will occur if the run voltage is less than 4.9 volts and the rear system voltage is less than 8.9 volts, and the brakes are active.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS. The front brakes regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 037
REAR SYSTEM VOLTAGE LOW

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.
- Clear BTCM DTCs, then cycle vehicle OFF, then back ON.

Does the DTC reset?

No → Problem intermittent. Refer to Diagnostic Aids.

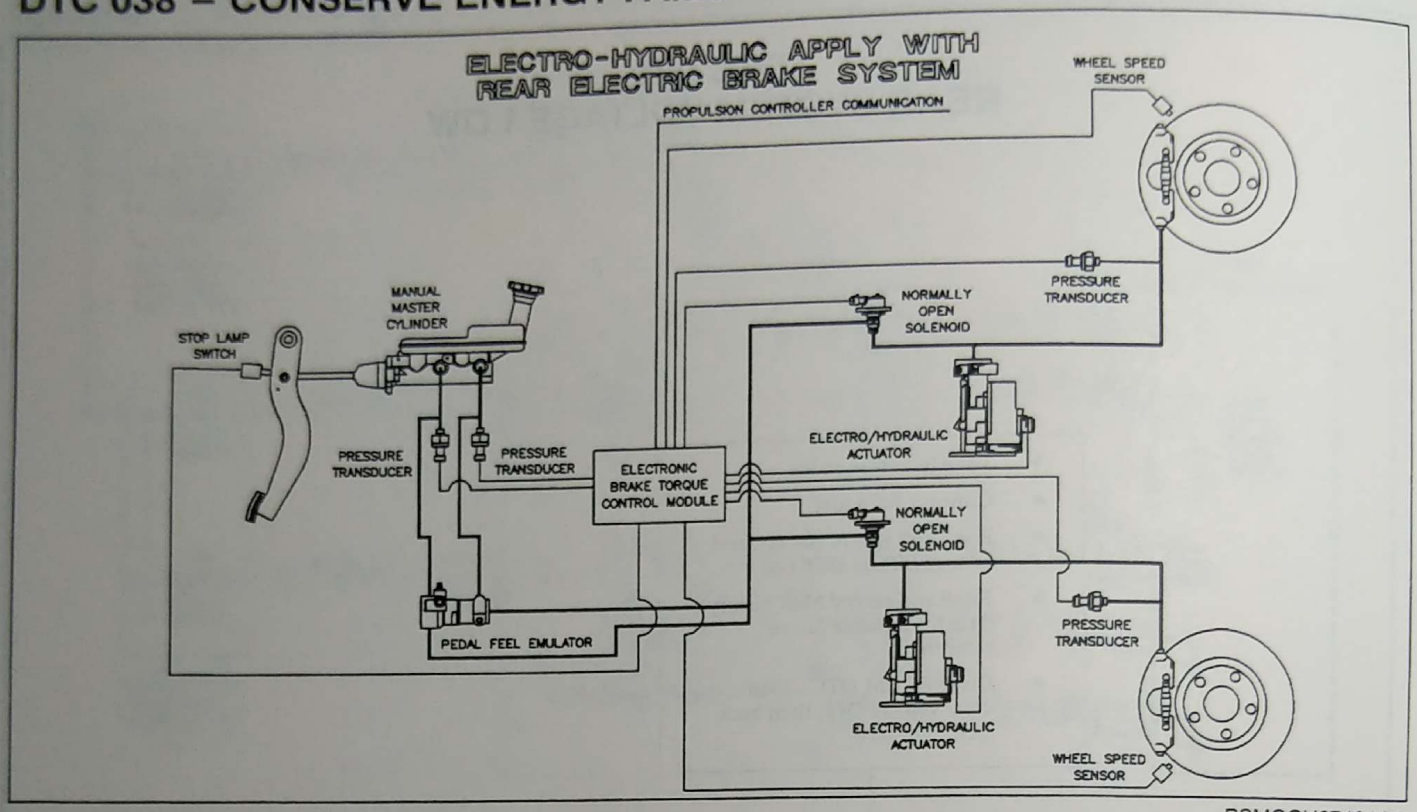
Yes

Current DTC 37 will not set in any known failure conditions.

If DTC 37 is set contact Technical Assistance.

CamScanner

DTC 038 – CONSERVE ENERGY FAILURE



PSMGCH67421AA

CONSERVE ENERGY FAILURE

The brake torque control module (BTCM) monitors the downstream pressure while in conserve energy mode. If the system is not able to maintain constant downstream pressure reduced motor life may result.

DTC PARAMETERS

DTC 038 will set if:

- Malfunctioning solenoid.
- Leaking hydraulic circuit (downstream).
- Malfunctioning electromagnetic brake.
- Modulator or motor pack assembly fail to hold pressure.

DTC 038 will set when:

This fault can set anytime the front motors enter the conserve energy mode. A fault exists if either the left front or right front downstream pressure decreases 831 kPa (121 psi) below the initial pressure reading within one second of entering conserve energy mode.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

Possibly: BTCM 051, 054 (front channel pressure errors), BTCM 071 and/or BTCM 074 (front max motor current failures).

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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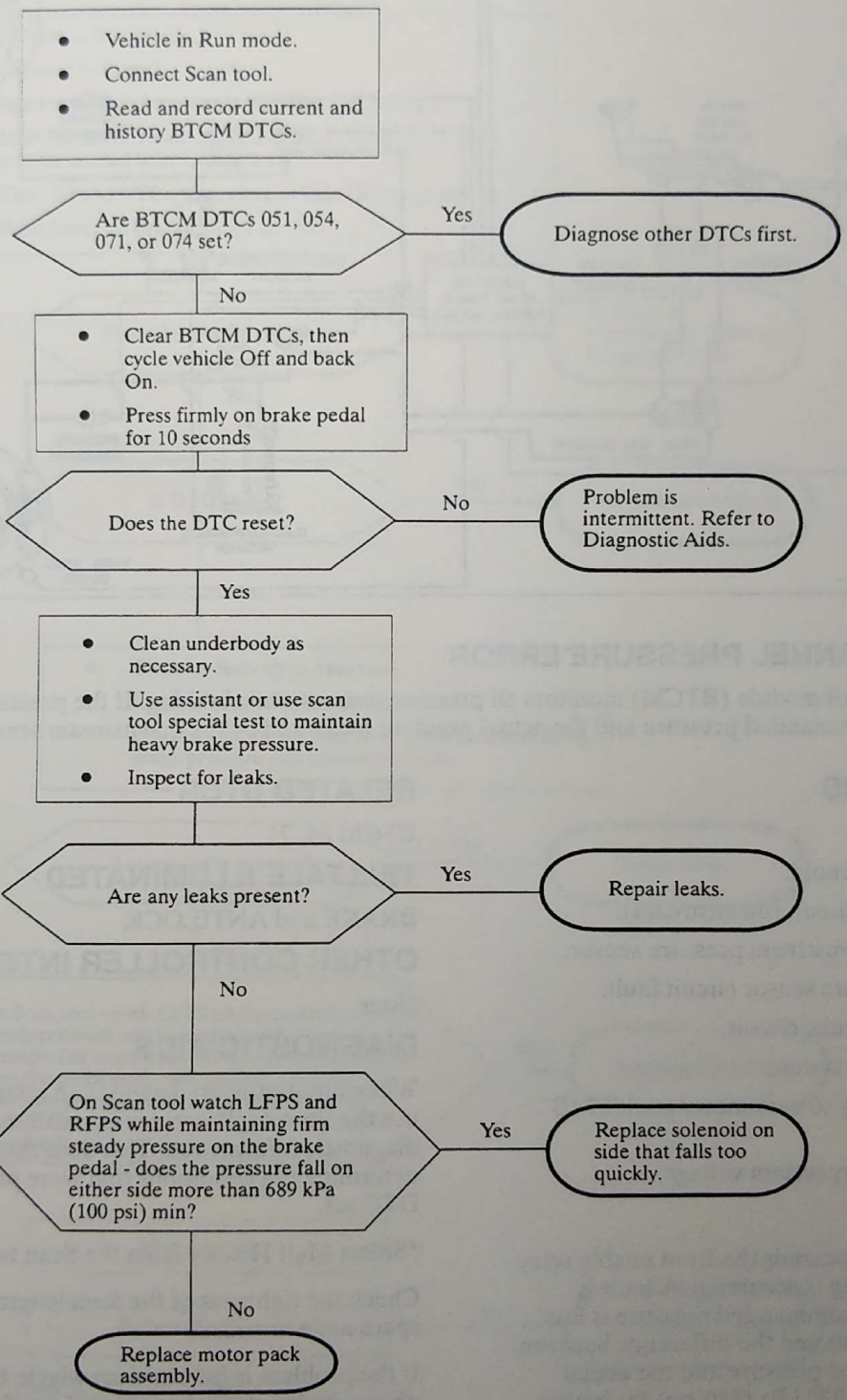
DTC 038
CONSERVE ENERGY FAILURE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are BTCM DTCs 051, 054, 071, or 074 set?
Yes
Diagnose other DTCs first.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Press firmly on brake pedal for 10 seconds
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Clean underbody as necessary.
Use assistant or use scan tool special test to maintain heavy brake pressure.
Inspect for leaks.
Are any leaks present?
Yes
Repair leaks.
No
On Scan tool watch LFPS and RFPS while maintaining firm steady pressure on the brake pedal - does the pressure fall on either side more than 689 kPa (100 psi) min?
Yes
Replace solenoid on side that falls too quickly.
No
Replace motor pack assembly.

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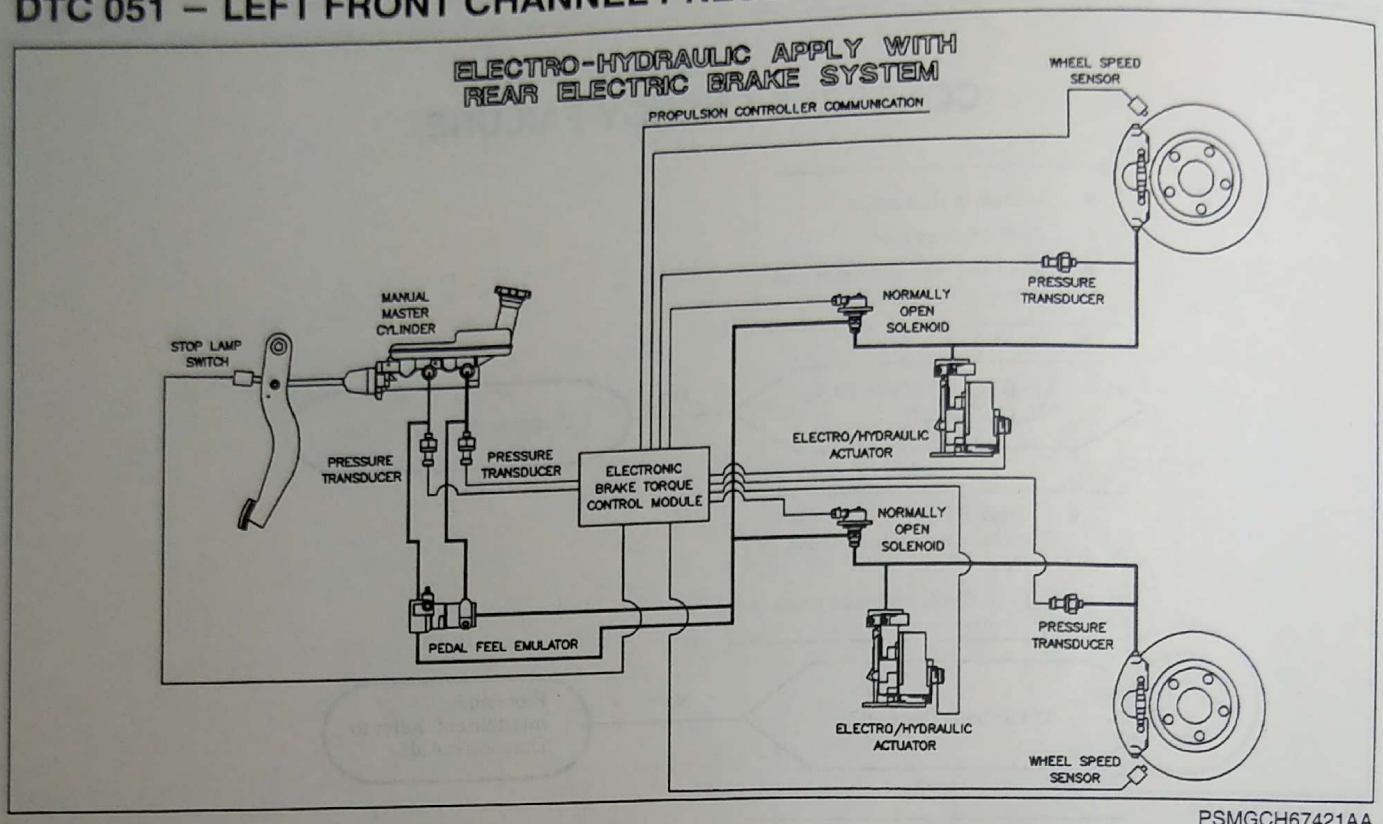
DTC 051 – LEFT FRONT CHANNEL PRESSURE ERROR



PSMGCH67421AA

LEFT FRONT CHANNEL PRESSURE ERROR

The brake torque control module (BTCM) monitors all pressure sensors while braking. If the pressure differential between the BTCM commanded pressure and the actual pressure measured by the downstream sensor is too great this fault will be set.

DTC PARAMETERS

DTC 051 will set if:

- Malfunctioning solenoid.
- Leaking hydraulic circuit (downstream).
- Malfunctioning downstream pressure sensor.
- Downstream pressure sensor circuit fault.
- Restriction in hydraulic circuit.
- Air in the hydraulic system.
- Modulator assembly to wire motor pack/EMB assembly failure.
- Low auxiliary battery system voltage.

DTC 051 will set when:

Anytime the BTCM commands the front enable relay On and non-ABS braking is occurring. A fault is present if the left front commanded pressure is less than 11431 kPa (1658 psi) and the difference between the left front commanded pressure and the actual pressure is greater than 970 kPa (140 psi) for longer than 500 milliseconds.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 64, 71

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

Low auxiliary battery voltage (battery or APM) can cause this DTC to set. Try setting DTC in off state. If DTC only sets in off state, monitor auxiliary battery voltage while applying brakes in the Lock mode. If the voltage drops below 10 volts check the auxiliary battery per "Battery and Charging Service Manual."

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DTC 051
LEFT FRONT CHANNEL PRESSURE ERROR

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- **IMPORTANT:** Read and record malf history data. This may be needed later in diagnosis.
- Clear BTCM DTCs, then cycle vehicle Off and back On.
- Press firmly on brakes for 10 seconds.

Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

Is DTC 64 set?

Yes → Replace motor pack.

No

- Clean underbody as necessary.
- Inspect for pinched or damaged lines.
- Use assistant or use scan tool test to maintain heavy brake pressure and inspect for leaks.

Are any leaks present?

Yes → Repair leaks.

No

On Scan tool watch LFPS while maintaining firm, steady pressure on the brake pedal - does the pressure fall more than 689 kPa (100 psi) min or does the pedal push back against your foot (the first time you apply the brake after going to RUN)? To repeat condition, select OFF/ACC, then RUN again.

Yes → Replace left solenoid.

No

Bleed system.

Does DTC 51 reset?

No → Condition is repaired.

Yes

Replace motor pack.

IMPORTANT: Follow motor pack, Brake Pressure Modulator Valve R and R procedure in this manual to avoid false DTC resetting and misdiagnosis.

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DTC 052 – LEFT FRONT CHANNEL IN RELEASE TOO LONG WHILE IN ABS

This fault can only be set while in an ABS stop. A fault exists if ABS is active, the left front wheel is in a release mode and the left front wheel pressure is less than 277 kPa (40 psi) for 1.5 seconds.

DTC PARAMETERS

DTC 052 will set if:

- DTC 21 conditions present during an ABS stop.
- Base brake dragging.
- Modulator or motor pack assembly failure.

DTC 052 will set when:

DTC 052 can only be set while in an ABS stop. A fault exists if ABS is active, the left front wheel is in a release mode and the left front wheel pressure is less than 277 kPa (40 psi) for 1.5 seconds.

This may occur in rare instances on extremely slippery surfaces.

FAILURE ACTION

If this failure is detected the brake torque control module (BTCM) will disable front ABS and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

BTCM 21

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

Verify whether vehicle has been driven on extremely slippery surfaces. If yes, this DTC may be a normal result of the road condition.

This is the likely cause if malf history indicates fault only occured one time.

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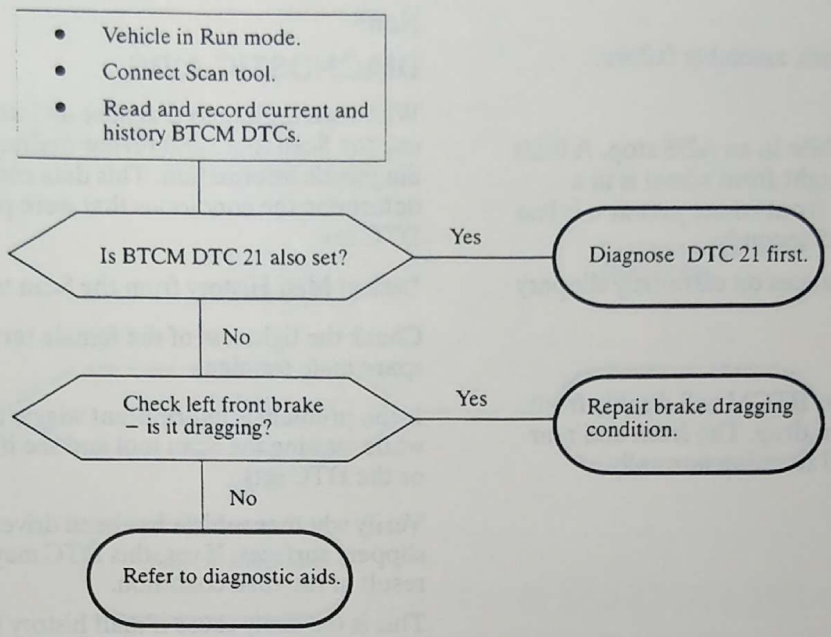
DTC 052
LEFT FRONT CHANNEL IN RELEASE TOO LONG WHILE IN ABS



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DTC 053 – RIGHT FRONT CHANNEL IN RELEASE TOO LONG WHILE IN ABS

This fault can only be set while in an ABS stop. A fault exists if ABS is active, the right front wheel is in a release mode and the right front wheel pressure is less than 277 kPa (40 psi) for 1.5 seconds.

DTC PARAMETERS

DTC 053 will set if:

- DTC 22 conditions present during an ABS stop.
- Base brake dragging.
- Modulator or motor pack assembly failure.

DTC 053 will set when:

DTC 053 can only be set while in an ABS stop. A fault exists if ABS is active, the right front wheel is in a release mode and the right front wheel pressure is less than 277 kPa (40 psi) for 1.5 seconds.

This may occur in rare instances on extremely slippery surfaces.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and reduce coast down drag. The front and rear brake system and regen will function normally.

RELATED DTCS

BTCM 22

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

Verify whether vehicle has been driven on extremely slippery surfaces. If yes, this DTC may be a normal result of the road condition.

This is the likely cause if malf history indicates fault only occured one time.

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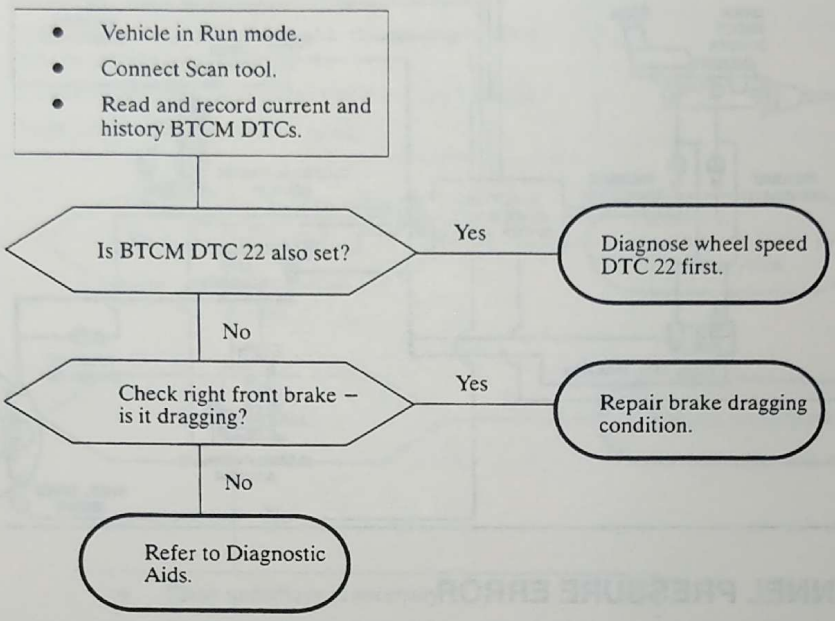
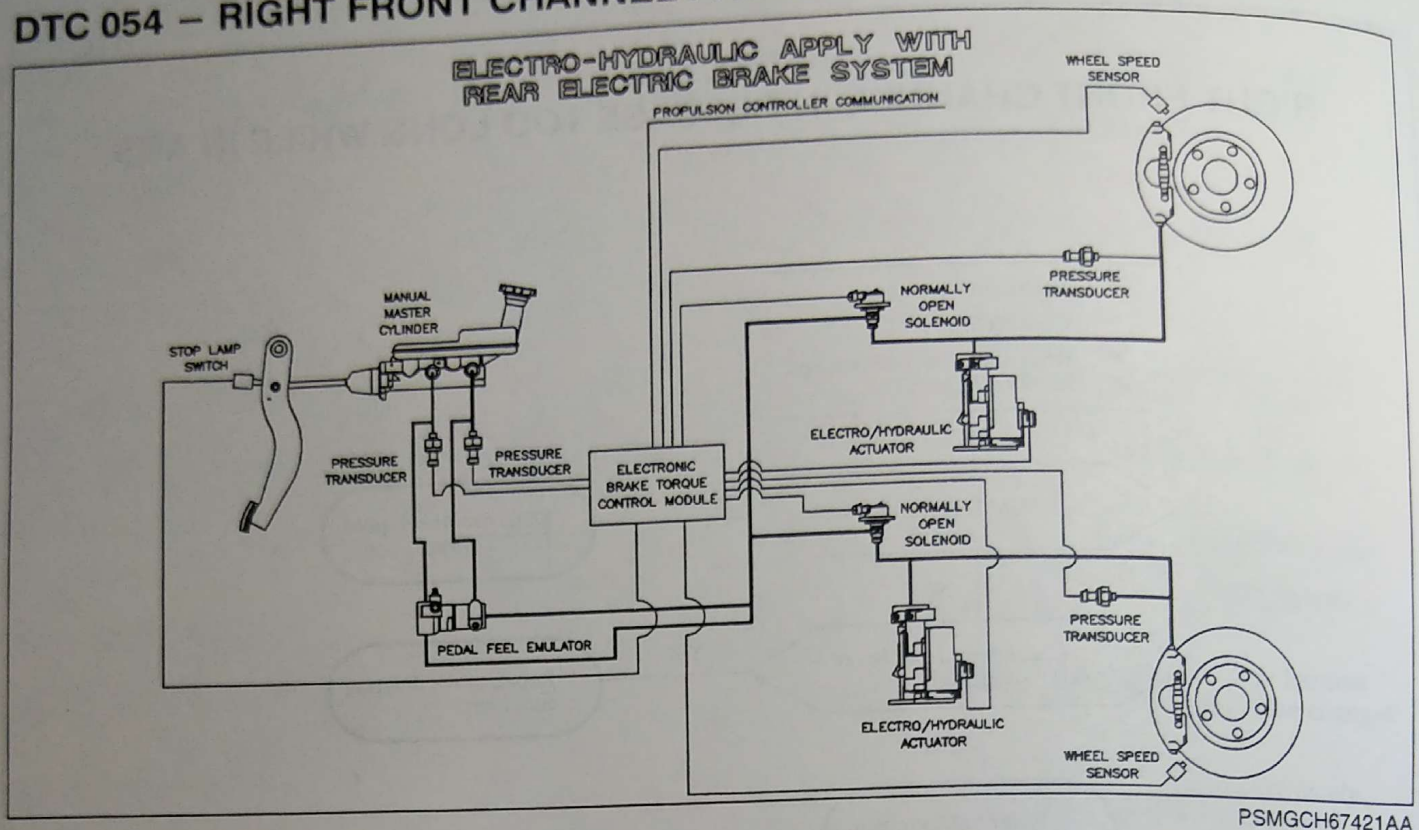
DTC 053
RIGHT FRONT CHANNEL IN RELEASE TOO LONG WHILE IN ABS



CamScanner

DTC 054 – RIGHT FRONT CHANNEL PRESSURE ERROR



PSMGCH67421AA

RIGHT FRONT CHANNEL PRESSURE ERROR

The brake torque control module (BTCM) monitors all pressure sensors while braking. If the pressure differential between the BTCM commanded pressure and the actual pressure measured by the downstream sensor is too great this fault will be set.

DTC PARAMETERS

DTC 054 will set if:

- Malfunctioning solenoid.
- Leaking hydraulic circuit (downstream).
- Malfunctioning downstream pressure sensor.
- Downstream pressure sensor circuit fault.
- Restriction in the hydraulic circuit.
- Air in the hydraulic system.
- Modulator or motor pack assembly failure.
- Low auxiliary battery system voltage.

DTC 054 will set when:

Anytime the BTCM commands the front enable relay On and non-ABS braking is occurring. A fault is present if the right front commanded pressure is less than 11431 kPa (1658 psi) and the difference between the right front commanded pressure and the actual pressure is greater than 970 kPa (140 psi) for longer than 500 milliseconds.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 65, 71

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

Low auxiliary battery voltage (battery or APM) can cause this DTC to set. Try setting DTC in off state. If DTC only sets in off state monitor auxiliary battery voltage while applying brakes in the Lock mode. If the voltage drops below 10 volts check the auxiliary battery per "Battery and Charging Service Manual."

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DTC 054
RIGHT FRONT CHANNEL PRESSURE ERROR

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- **IMPORTANT**: Read and record Malf history data. This may be needed later in diagnosis.
- Clear BTCM DTCs, then cycle vehicle Off and back On.
- Press firmly on brakes for 10 seconds.

Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

Is DTC 65 set?

Yes → Replace motor pack.

No

- Clean underbody as necessary.
- Use assistant or use Scan tool test to maintain heavy brake pressure.
- Inspect for leaks.

Are any leaks present?

Yes → Repair leaks.

No

On Scan tool watch RFPS while maintaining firm, steady pressure on the brake pedal - does the pressure fall more than 100 psi/min or does the pedal push back against your foot (the first time you apply the brake after going to RUN)? To repeat condition select OFF/ACC then RUN again.

Yes → Replace left solenoid.

No

Bleed system.

Does DTC 54 reset?

No → Condition is repaired.

Yes

Replace motor pack.

IMPORTANT: Follow motor pack, Brake Pressure Modulator Valve R and R procedure in this manual to avoid false DTC resetting and misdiagnosis.

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DTC 055 – FRONT MOTOR/EMB DRIVER FAULT

If the brake torque control module (BTCM) detects a fault with the front motor driver chip it will disable front ABS and front power assist base brakes.

DTC PARAMETERS

DTC 055 will set if:

The front motor driver chip has failed.

DTC 055 will set when:

Anytime the BTCM commands the front enable relay On.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 055
FRONT MOTOR/EMB DRIVER FAULT

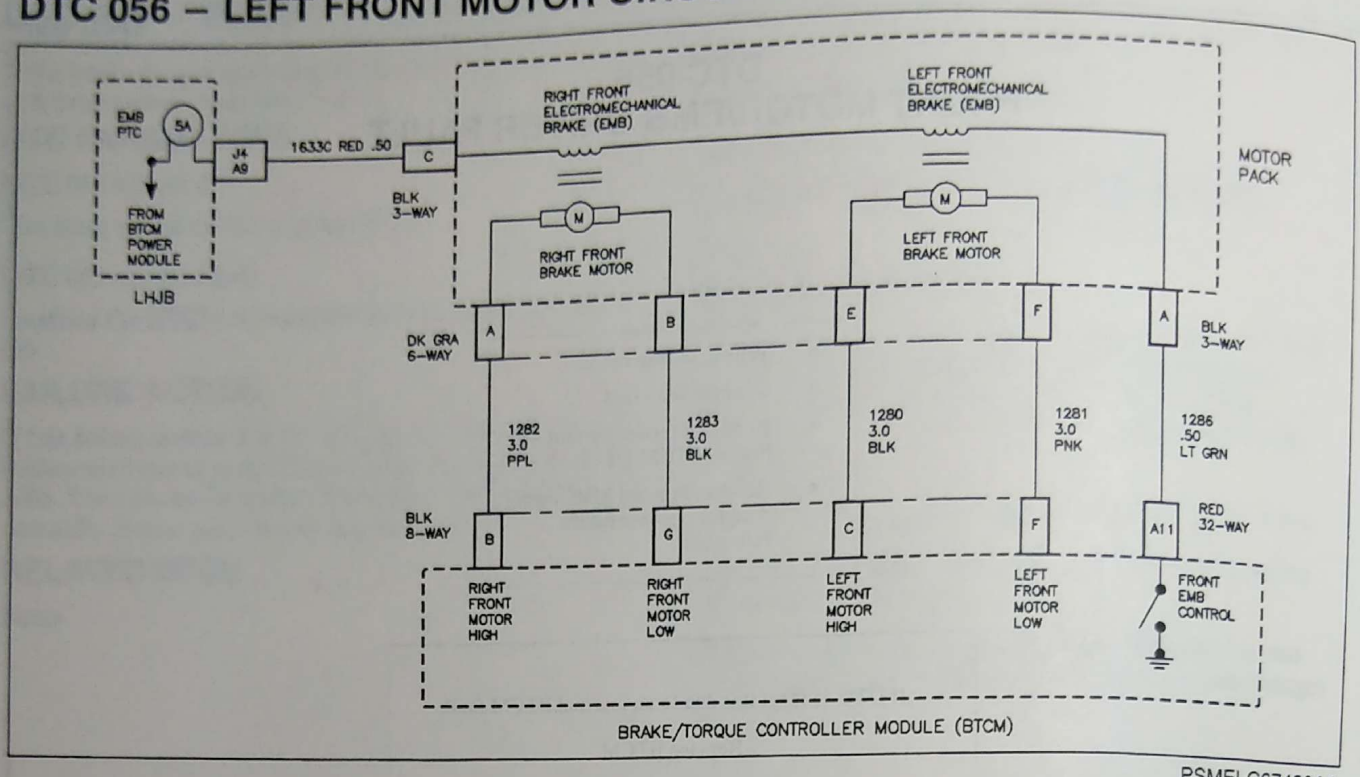
- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

If DTC 55 is set it is due to an internal BTCM fault.

Replace BTCM.

CamScanner

DTC 056 – LEFT FRONT MOTOR CIRCUIT OPEN



PSMELC67490AA

LEFT FRONT MOTOR CIRCUIT OPEN

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This DTC is set if an open is detected in the motor circuit.

DTC PARAMETERS

DTC 056 will set if:

- Open circuit between the BTCM and left front motor.
- Open or high resistance motor armature winding.
- Malfunctioning motor driver circuit in the BTCM.

DTC 056 will set when:

Anytime the BTCM commands the front enable relay On and the left front motor is inactive (Off). The fault exists if the voltage at left front motor high is greater than 4.3 volts and the voltage at left front motor low is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

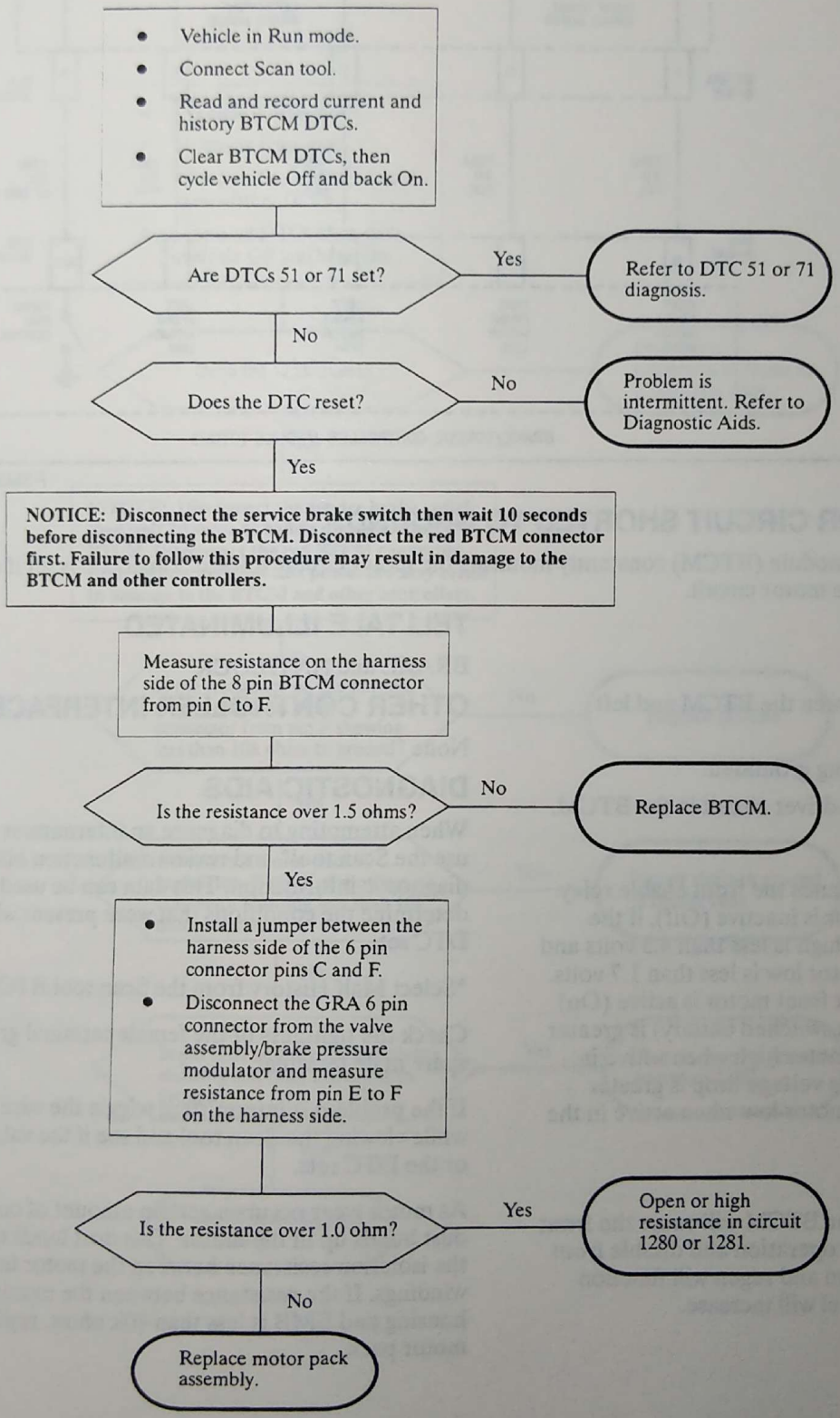
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

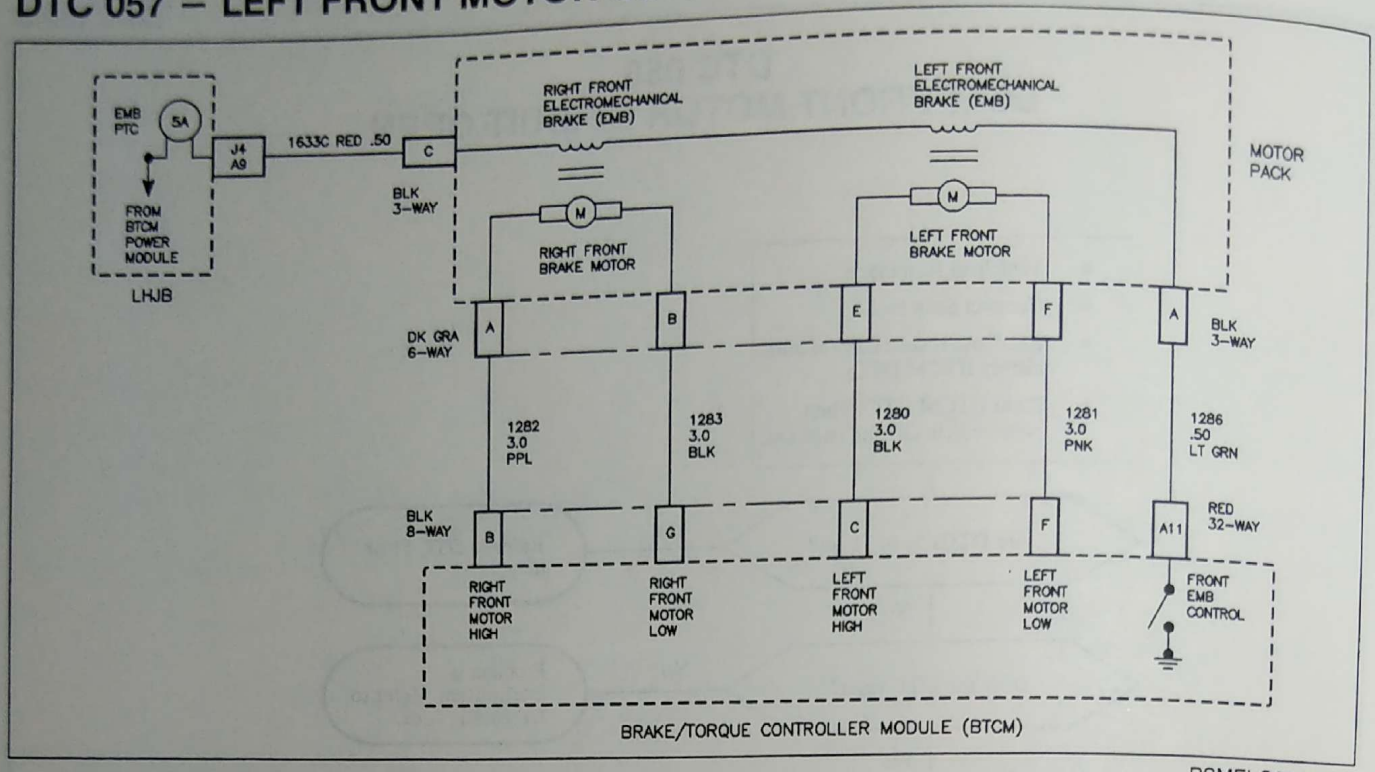
If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

This DTC may set intrmittently due to a sticking brush is the motor pack.

DTC 056
LEFT FRONT MOTOR CIRCUIT OPEN


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Are DTCs 51 or 71 set?
Yes
Refer to DTC 51 or 71 diagnosis.
No
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Measure resistance on the harness side of the 8 pin BTCM connector from pin C to F.
Is the resistance over 1.5 ohms?
No
Replace BTCM.
Yes
Install a jumper between the harness side of the 6 pin connector pins C and F.
Disconnect the GRA 6 pin connector from the valve assembly/brake pressure modulator and measure resistance from pin E to F on the harness side.
Is the resistance over 1.0 ohm?
Yes
Open or high resistance in circuit 1280 or 1281.
No
Replace motor pack assembly.

DTC 057 – LEFT FRONT MOTOR CIRCUIT SHORTED TO GROUND



PSMELC67490AA

LEFT FRONT MOTOR CIRCUIT SHORTED TO GROUND

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This DTC is set if a short to ground is detected in the motor circuit.

DTC PARAMETERS

DTC 057 will set if:

- Grounded circuit between the BTCM and left front motor.
- Motor armature winding grounded.
- Malfunctioning motor driver circuit in the BTCM.

DTC 057 will set when:

Anytime the BTCM commands the front enable relay On, and the left front motor is inactive (Off), if the voltage at left front motor high is less than 4.3 volts and the voltage at left front motor low is less than 1.7 volts. This DTC will set if the left front motor is active (On) and the voltage drop (from switched battery) is greater than 4.5 volts at left front motor high when active in the forward direction or the voltage drop is greater than 4.5 volts at left front motor low when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

As motor wear occurs a certain amount of conductive dust builds up in the motor. This dust tends to reduce the isolation resistance between the motor housing and windings. If the resistance between the motor pack housing and EMB is less than 40k ohms, replace the motor pack.

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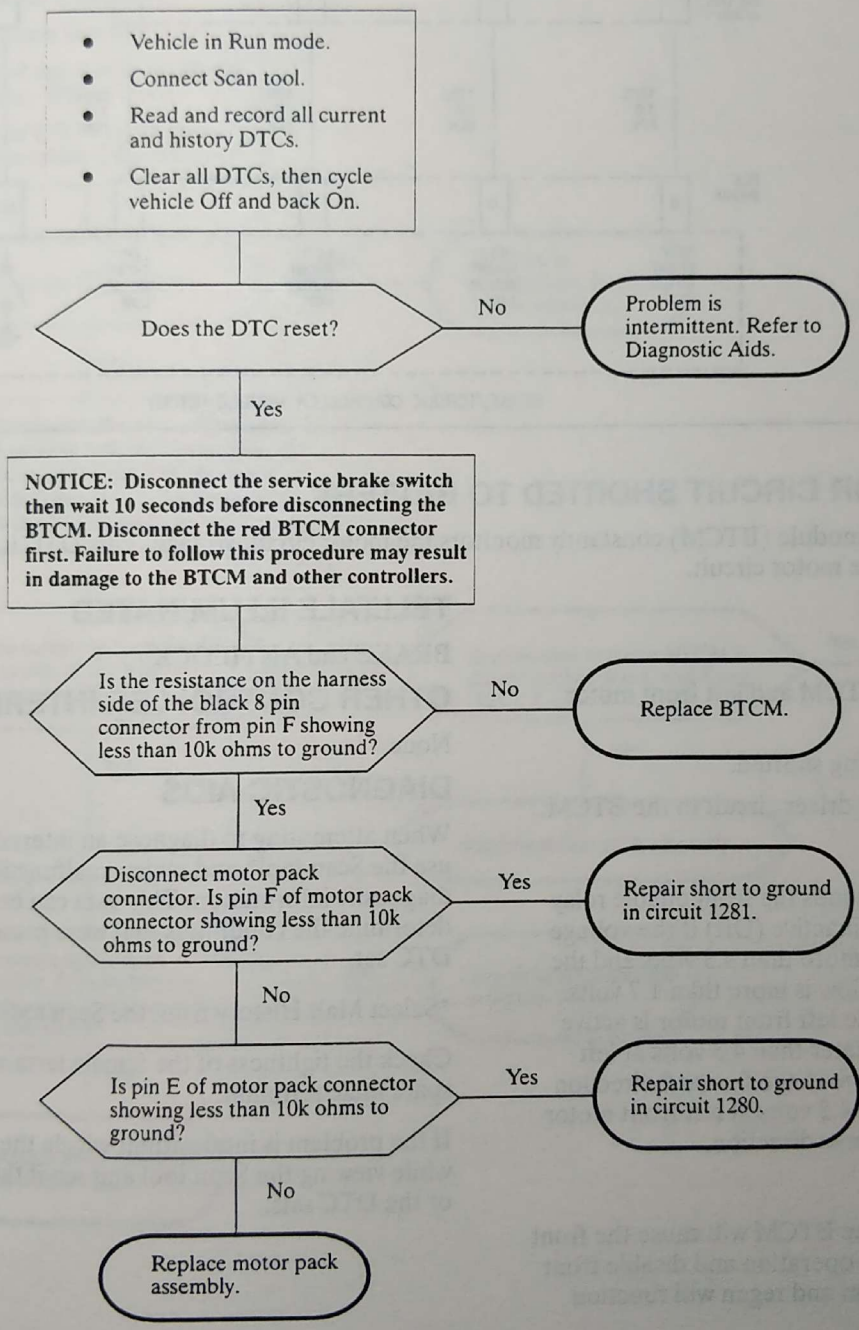
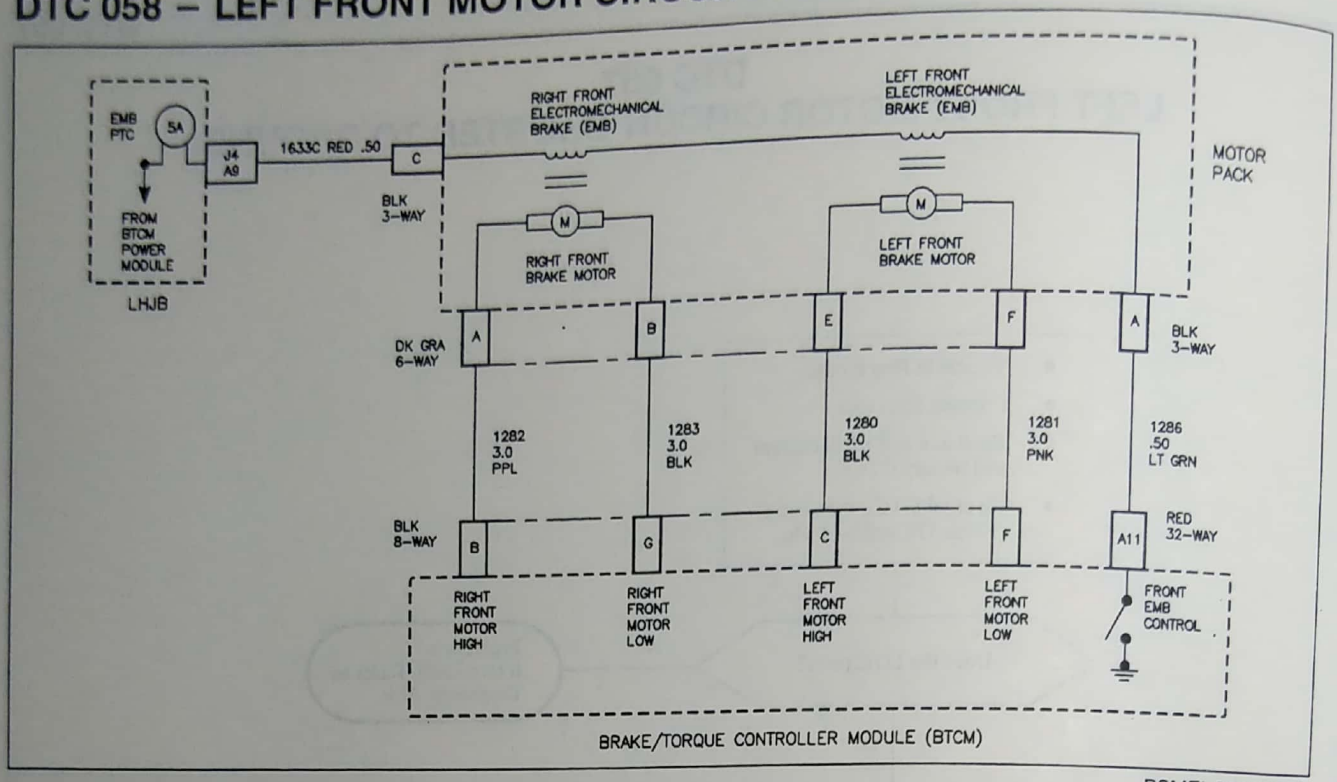
DTC 057
LEFT FRONT MOTOR CIRCUIT SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record all current and history DTCs.
Clear all DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is the resistance on the harness side of the black 8 pin connector from pin F showing less than 10k ohms to ground?
No
Replace BTCM.
Yes
Disconnect motor pack connector. Is pin F of motor pack connector showing less than 10k ohms to ground?
Yes
Repair short to ground in circuit 1281.
No
Is pin E of motor pack connector showing less than 10k ohms to ground?
Yes
Repair short to ground in circuit 1280.
No
Replace motor pack assembly.

DTC 058 – LEFT FRONT MOTOR CIRCUIT SHORTED TO BATTERY



PSMELC67490AA

LEFT FRONT MOTOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This DTC is set if a short to battery is detected in the motor circuit.

DTC PARAMETERS

DTC 058 will set if:

- Circuit between the BTCM and left front motor shorted to voltage.
- Motor armature winding shorted.
- Malfunctioning motor driver circuit in the BTCM.

DTC 058 will set when:

Anytime the BTCM commands the front enable relay On and left front motor is inactive (Off) if the voltage at left front motor high is more than 4.3 volts and the voltage at left front motor low is more than 1.7 volts. This DTC will also set if the left front motor is active (On) and the voltage is greater than 4.5 volts at left front motor high when active in the forward direction or the voltage greater than 4.5 volts at left front motor low when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

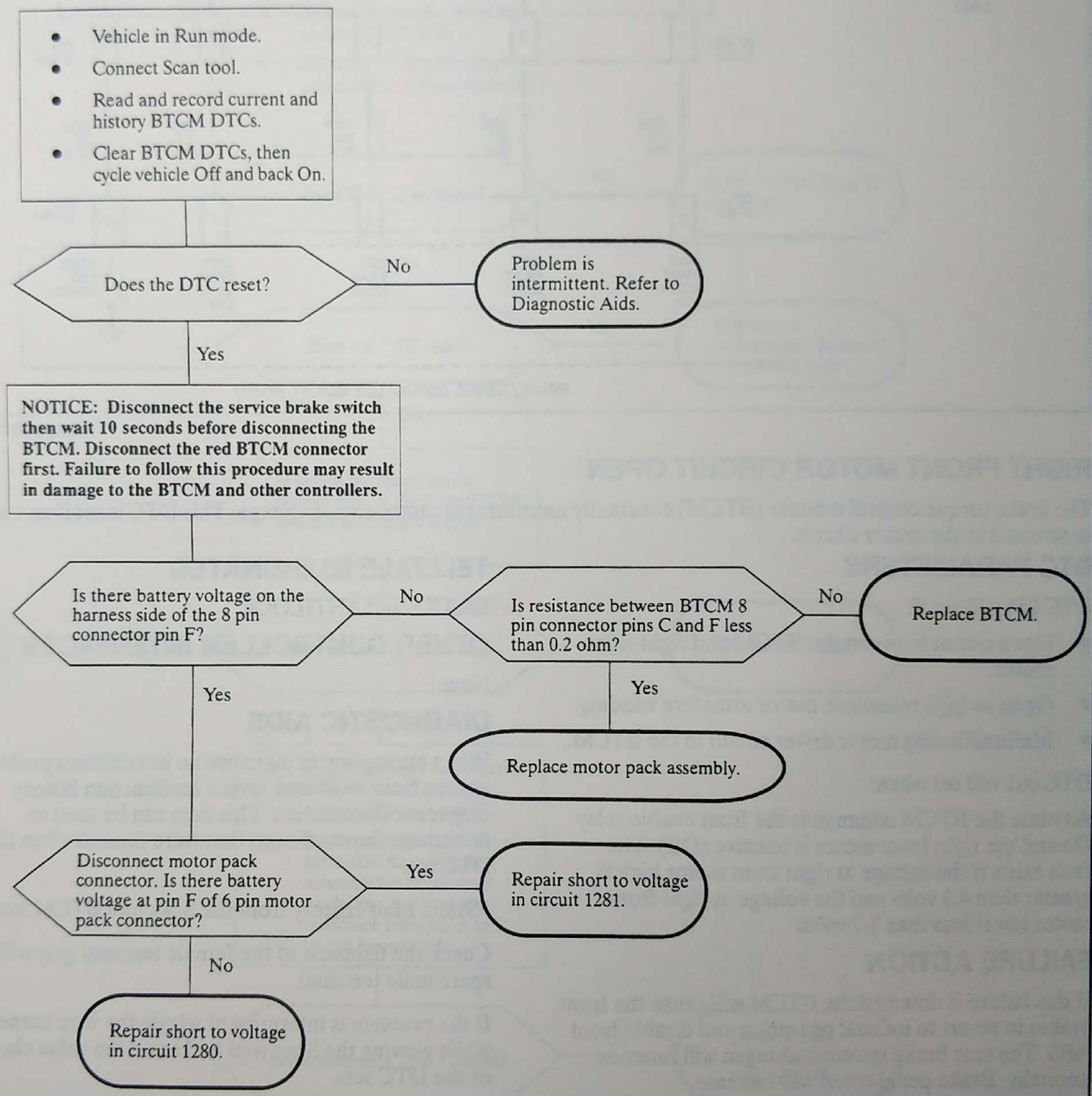
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 058
LEFT FRONT MOTOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is there battery voltage on the harness side of the 8 pin connector pin F?
No
Is resistance between BTCM 8 pin connector pins C and F less than 0.2 ohm?
No
Replace BTCM.
Yes
Yes
Replace motor pack assembly.
Disconnect motor pack connector. Is there battery voltage at pin F of 6 pin motor pack connector?
Yes
Repair short to voltage in circuit 1281.
No
Repair short to voltage in circuit 1280.

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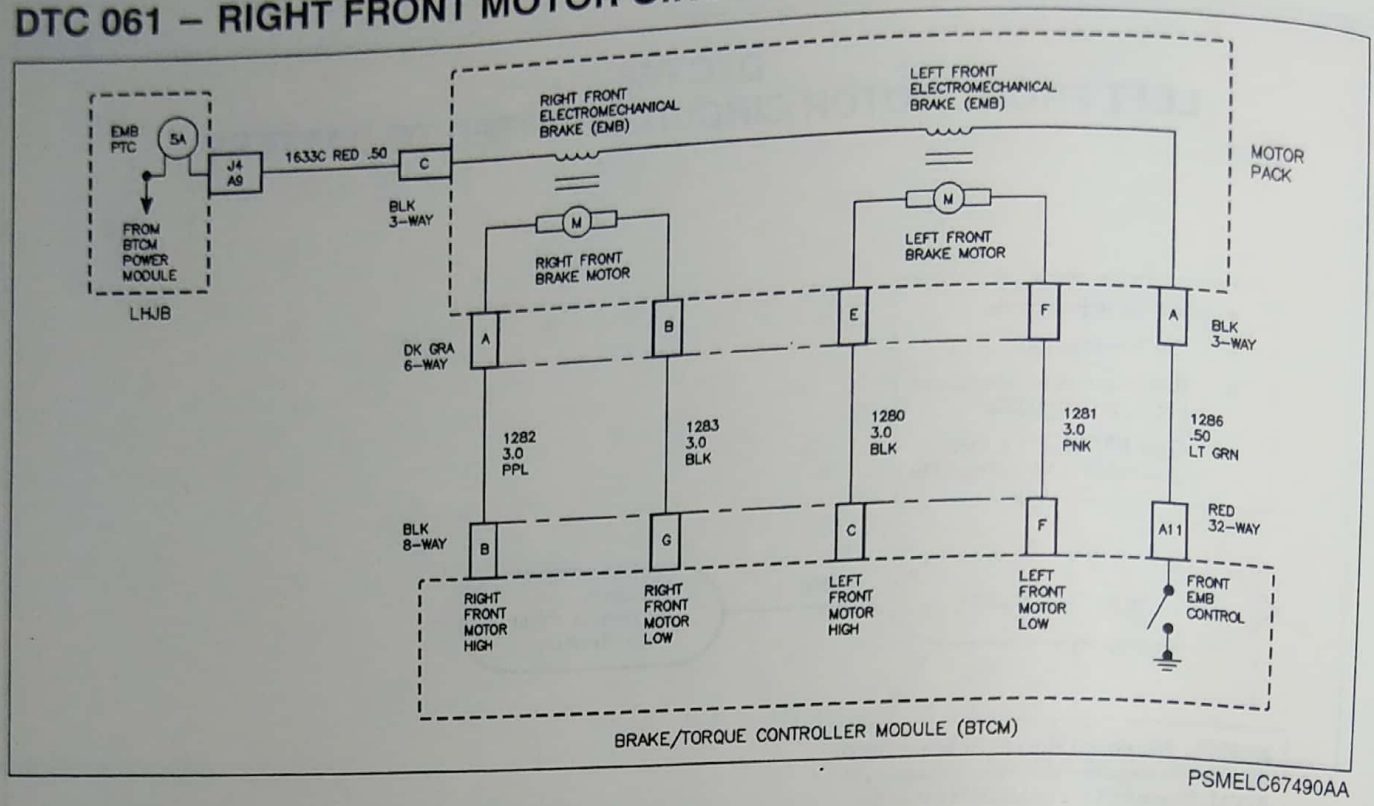
DTC 061 – RIGHT FRONT MOTOR CIRCUIT OPEN



PSMELC67490AA

RIGHT FRONT MOTOR CIRCUIT OPEN

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This DTC is set if an open is detected in the motor circuit.

DTC PARAMETERS

DTC 061 will set if:

- Open circuit between the BTCM and right front motor.
- Open or high resistance motor armature winding.
- Malfunctioning motor driver circuit in the BTCM.

DTC 061 will set when:

Anytime the BTCM commands the front enable relay On and the right front motor is inactive (Off). The fault exists if the voltage at right front motor high is greater than 4.3 volts and the voltage at right front motor low is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

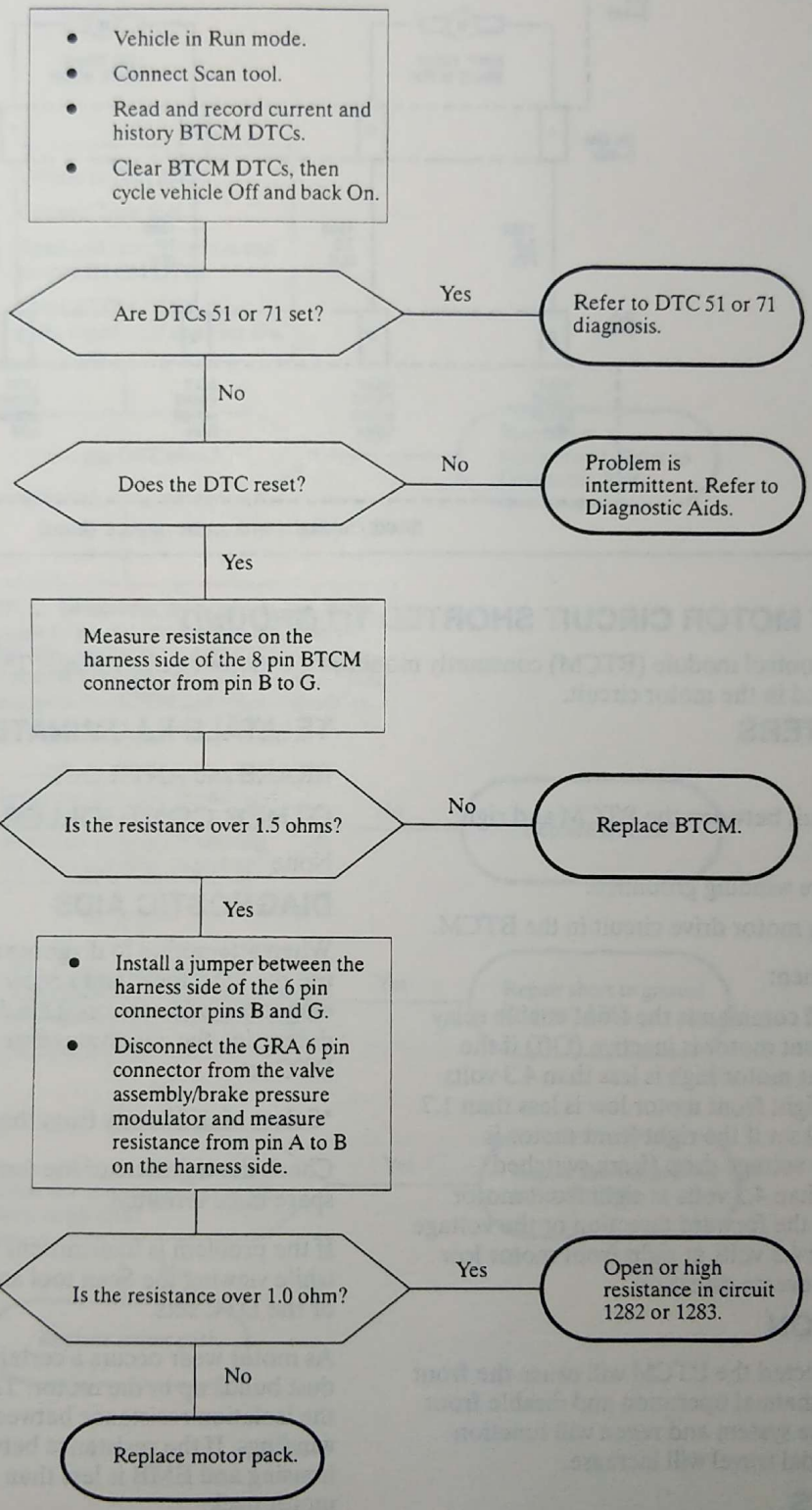
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

This DTC may set intermittently due to a sticking brush in the motor pack.

DTC 061
RIGHT FRONT MOTOR CIRCUIT OPEN


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Are DTCs 51 or 71 set?
Yes
Refer to DTC 51 or 71 diagnosis.
No
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Measure resistance on the harness side of the 8 pin BTCM connector from pin B to G.
Is the resistance over 1.5 ohms?
No
Replace BTCM.
Yes
Install a jumper between the harness side of the 6 pin connector pins B and G.
Disconnect the GRA 6 pin connector from the valve assembly/brake pressure modulator and measure resistance from pin A to B on the harness side.
Is the resistance over 1.0 ohm?
Yes
Open or high resistance in circuit 1282 or 1283.
No
Replace motor pack.

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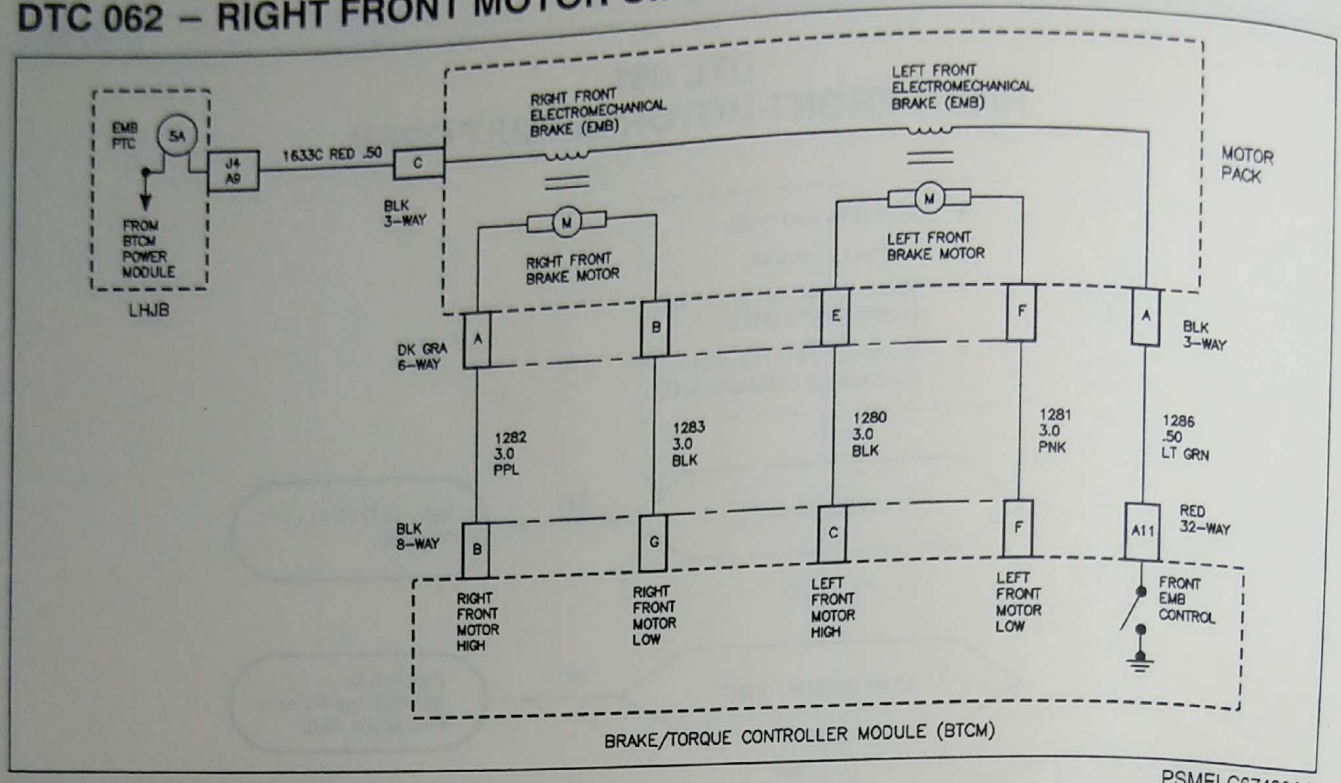
DTC 062 – RIGHT FRONT MOTOR CIRCUIT SHORTED TO GROUND



PSMELC67490AA

RIGHT FRONT MOTOR CIRCUIT SHORTED TO GROUND

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This DTC is set if a short to ground is detected in the motor circuit.

DTC PARAMETERS

DTC 062 will set if:

- Grounded circuit between the BTCM and right front motor.
- Motor armature winding grounded.
- Malfunctioning motor drive circuit in the BTCM.

DTC 062 will set when:

Anytime the BTCM commands the front enable relay On and the right front motor is inactive (Off) if the voltage at right front motor high is less than 4.3 volts and the voltage at right front motor low is less than 1.7 volts. This DTC will set if the right front motor is active (On) and the voltage drop (from switched battery) is greater than 4.5 volts at right front motor high when active in the forward direction or the voltage drop is greater than 4.5 volts at right front motor low when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

As motor wear occurs a certain amount of conductive dust builds up in the motor. This dust tends to reduce the isolation resistance between the motor housing and windings. If the resistance between the motor pack housing and EMB is less than 40k ohms, replace the motor pack.

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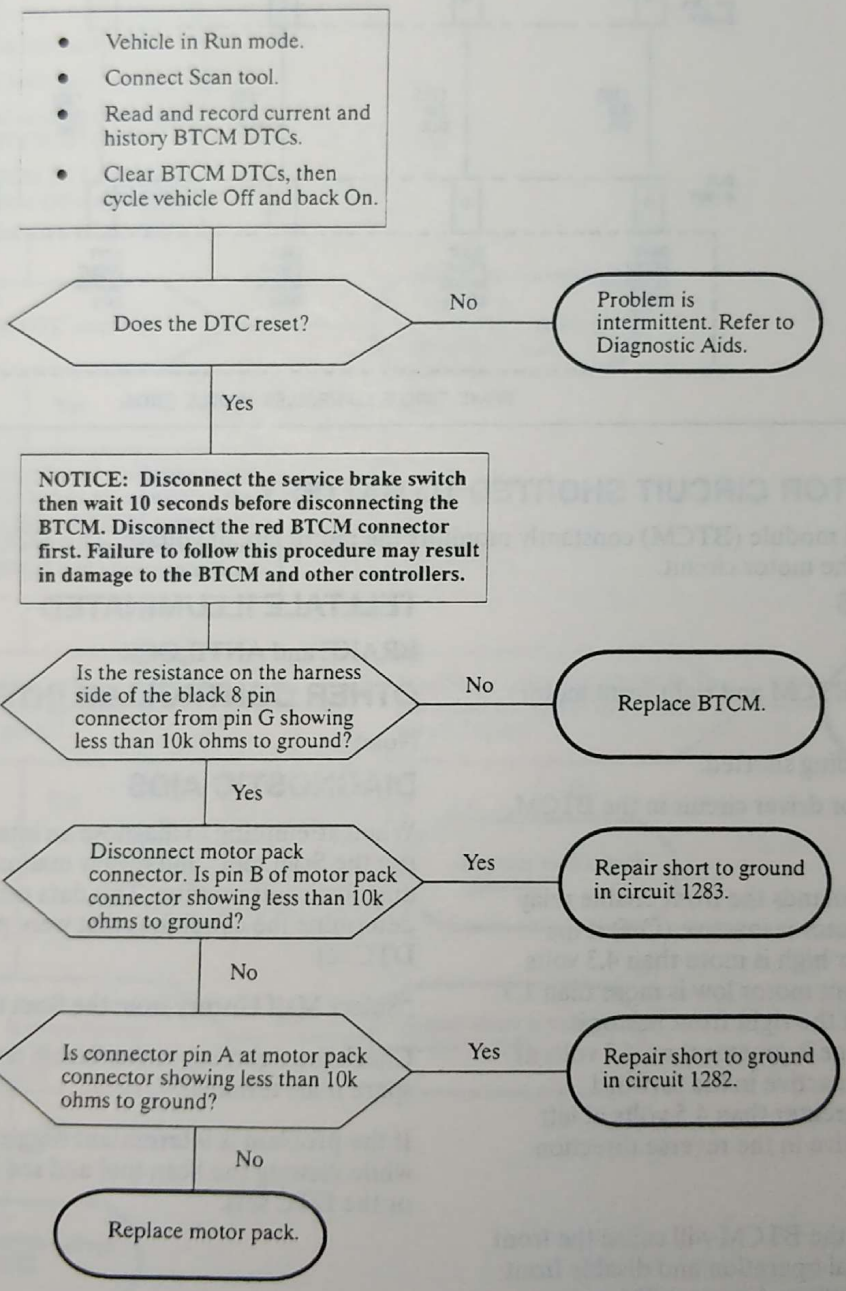
DTC 062
RIGHT FRONT MOTOR CIRCUIT SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is the resistance on the harness side of the black 8 pin connector from pin G showing less than 10k ohms to ground?
No
Replace BTCM.
Yes
Disconnect motor pack connector. Is pin B of motor pack connector showing less than 10k ohms to ground?
Yes
Repair short to ground in circuit 1283.
No
Is connector pin A at motor pack connector showing less than 10k ohms to ground?
Yes
Repair short to ground in circuit 1282.
No
Replace motor pack.

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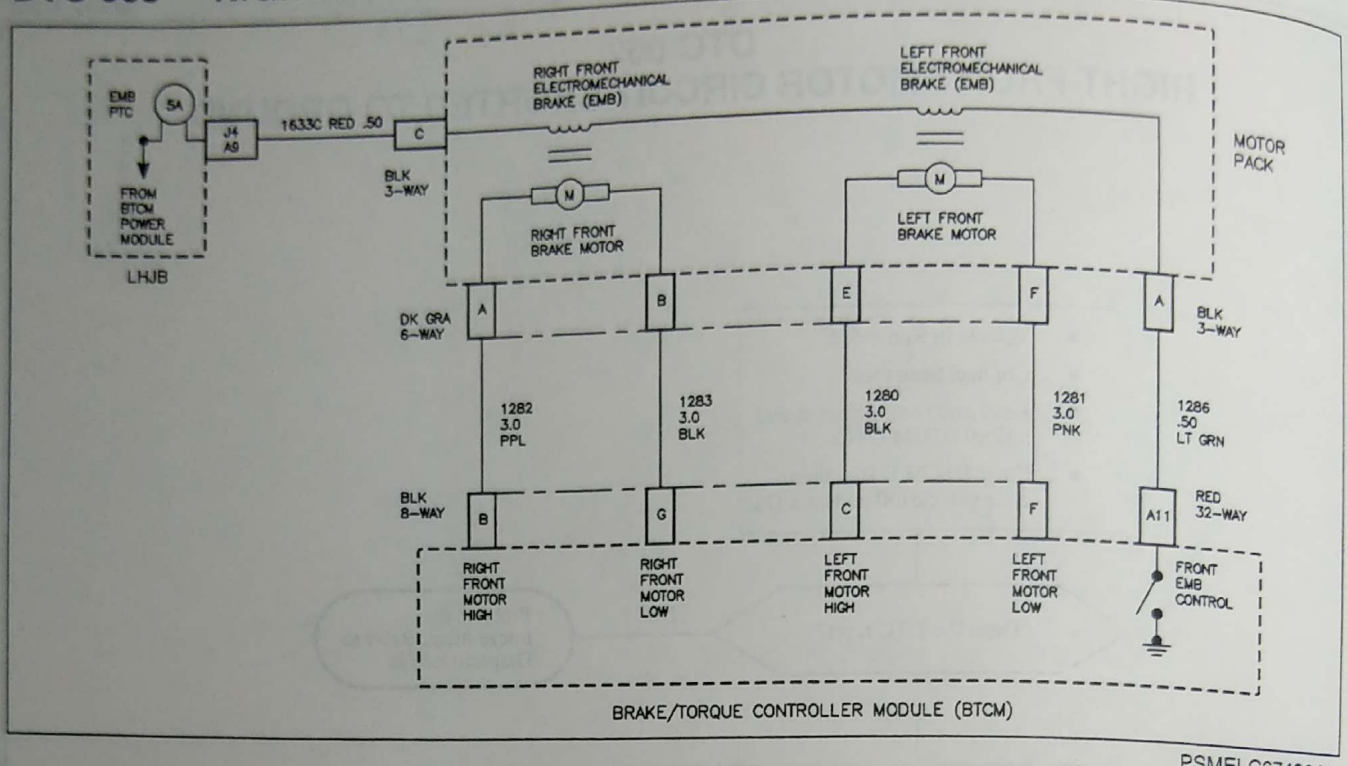
DTC 063 – RIGHT FRONT MOTOR CIRCUIT SHORTED TO BATTERY



PSMELC67490AA

RIGHT FRONT MOTOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This DTC is set if a short to battery is detected in the motor circuit.

DTC PARAMETERS

DTC 063 will set if:

- Circuit between the BTCM and right front motor shorted to voltage.
- Motor armature winding shorted.
- Malfunctioning motor driver circuit in the BTCM.

DTC 063 will set when:

Anytime the BTCM commands the front enable relay On and the right front motor is inactive (Off) if the voltage at left front motor high is more than 4.3 volts and the voltage at left front motor low is more than 1.7 volts. This DTC will set if the right front motor is active (On) and the voltage is greater than 4.5 volts at left front motor low when active in the forward direction or the voltage greater than 4.5 volts at left front motor low when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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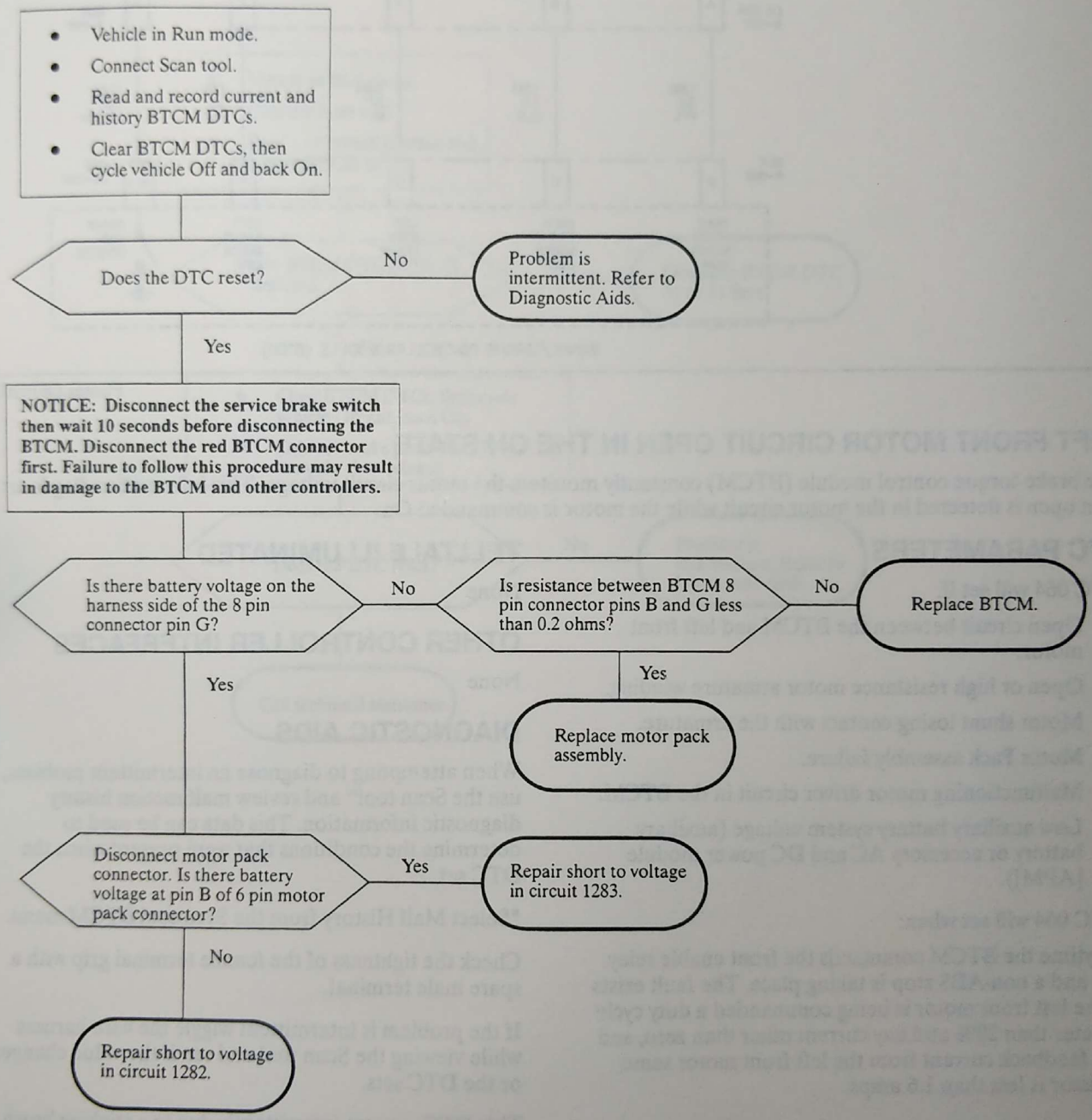
DTC 063
RIGHT FRONT MOTOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is there battery voltage on the harness side of the 8 pin connector pin G?
No
Is resistance between BTCM 8 pin connector pins B and G less than 0.2 ohms?
No
Replace BTCM.
Yes
Yes
Replace motor pack assembly.
Disconnect motor pack connector. Is there battery voltage at pin B of 6 pin motor pack connector?
Yes
Repair short to voltage in circuit 1283.
No
Repair short to voltage in circuit 1282.

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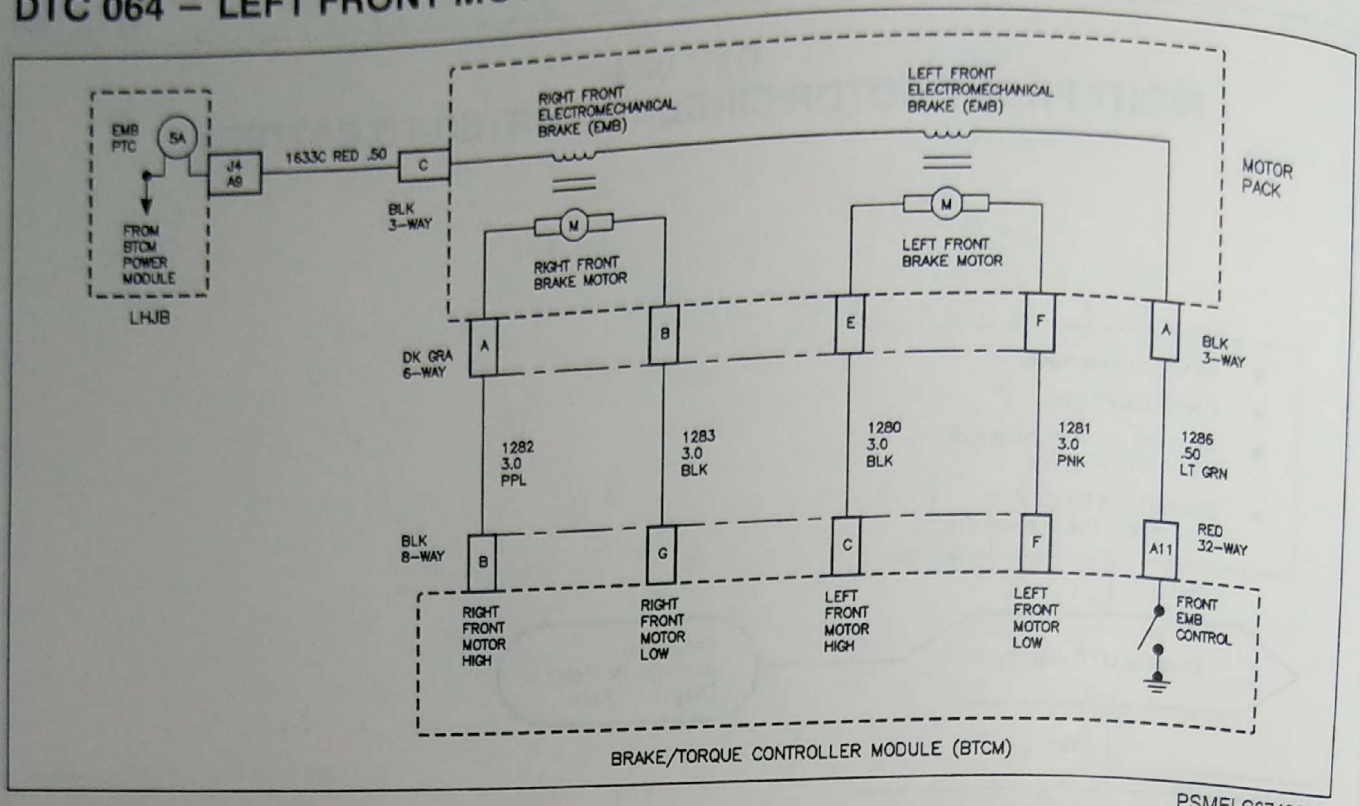
DTC 064 – LEFT FRONT MOTOR CIRCUIT OPEN IN THE ON STATE



PSMELC67490AA

LEFT FRONT MOTOR CIRCUIT OPEN IN THE ON STATE

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This information flag is set if an open is detected in the motor circuit while the motor is commanded On.

DTC PARAMETERS

DTC 064 will set if:

- Open circuit between the BTCM and left front motor.
- Open or high resistance motor armature winding.
- Motor shunt losing contact with the armature.
- Motor Pack assembly failure.
- Malfunctioning motor driver circuit in the BTCM.
- Low auxiliary battery system voltage (auxiliary battery or accessory AC and DC power module [APM]).

DTC 064 will set when:

Anytime the BTCM commands the front enable relay On and a non-ABS stop is taking place. The fault exists if the left front motor is being commanded a duty cycle greater than 20% and any current other than zero, and the feedback current from the left front motor sense resistor is less than 1.6 amps.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

There should always be a BTCM 51 and/or 71 set when this DTC is set.

TELLTALE ILLUMINATED

None

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

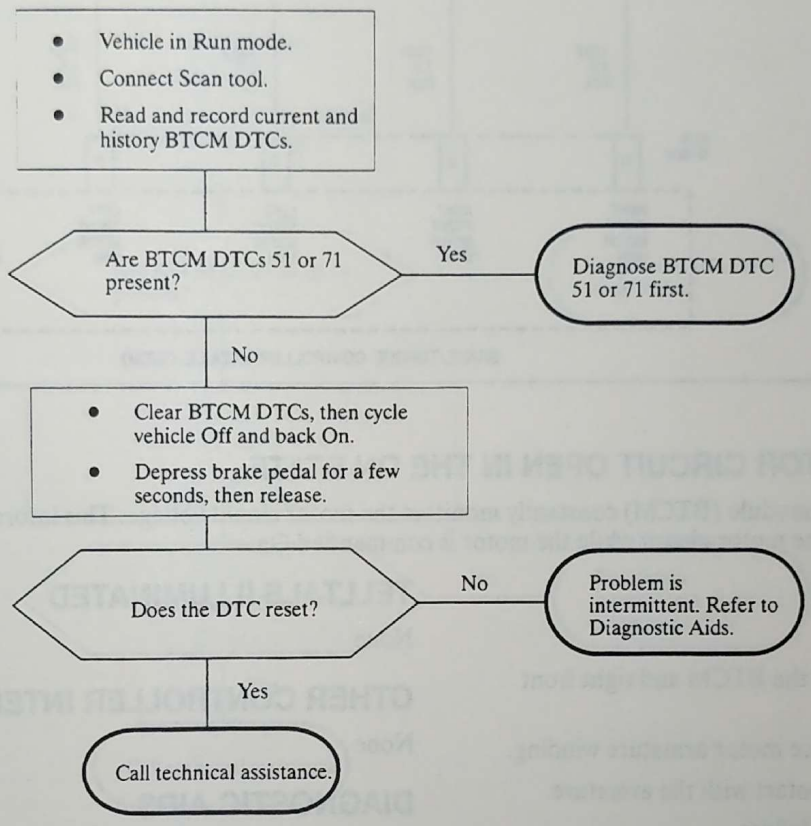
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

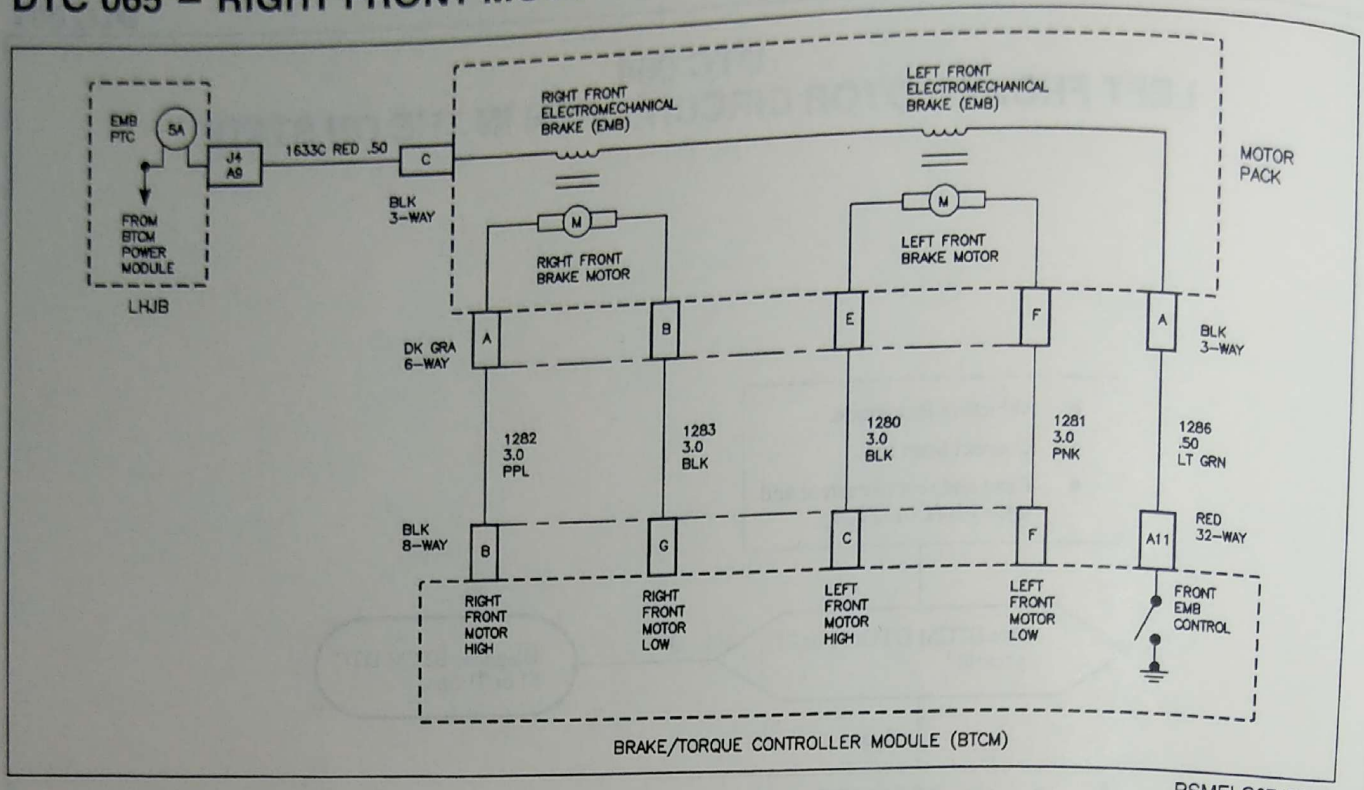
If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

This DTC may set intrmittently due to a sticking brush is the motor pack.

DTC 064
LEFT FRONT MOTOR CIRCUIT OPEN IN THE ON STATE


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record current and history BTCM DTCs.
Are BTCM DTCs 51 or 71 present?
Yes
Diagnose BTCM DTC 51 or 71 first.
No
• Clear BTCM DTCs, then cycle vehicle Off and back On.
• Depress brake pedal for a few seconds, then release.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Call technical assistance.

DTC 065 – RIGHT FRONT MOTOR CIRCUIT OPEN IN THE ON STATE



PSMELC67490AA

RIGHT FRONT MOTOR CIRCUIT OPEN IN THE ON STATE

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. This information flag is set if an open is detected in the motor circuit while the motor is commanded On.

DTC PARAMETERS

DTC 065 will set if:

- Open circuit between the BTCM and right front motor.
- Open or high resistance motor armature winding.
- Motor shunt losing contact with the armature.
- Motor Pack assembly failure.
- Malfunctioning motor driver circuit in the BTCM.
- Low auxiliary battery system voltage (auxiliary battery or accessory AC and DC power module [APM]).

DTC 065 will set when:

Anytime the BTCM commands the front enable relay On and a non-ABS stop is taking place. The fault exists if the right front motor is being commanded a duty cycle greater than 20% and a current other than zero and the feedback current from the right front motor sense resistor is less than 1.6 amps.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

There should always be a BTCM 54 and/or 74 set when this DTC is set.

TELLTALE ILLUMINATED

None

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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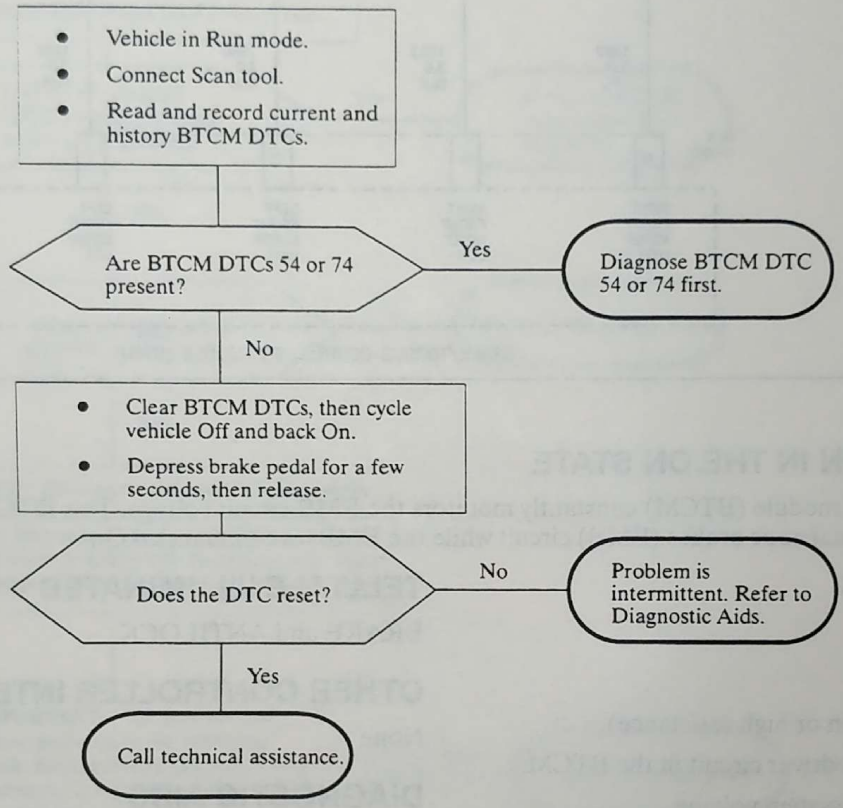
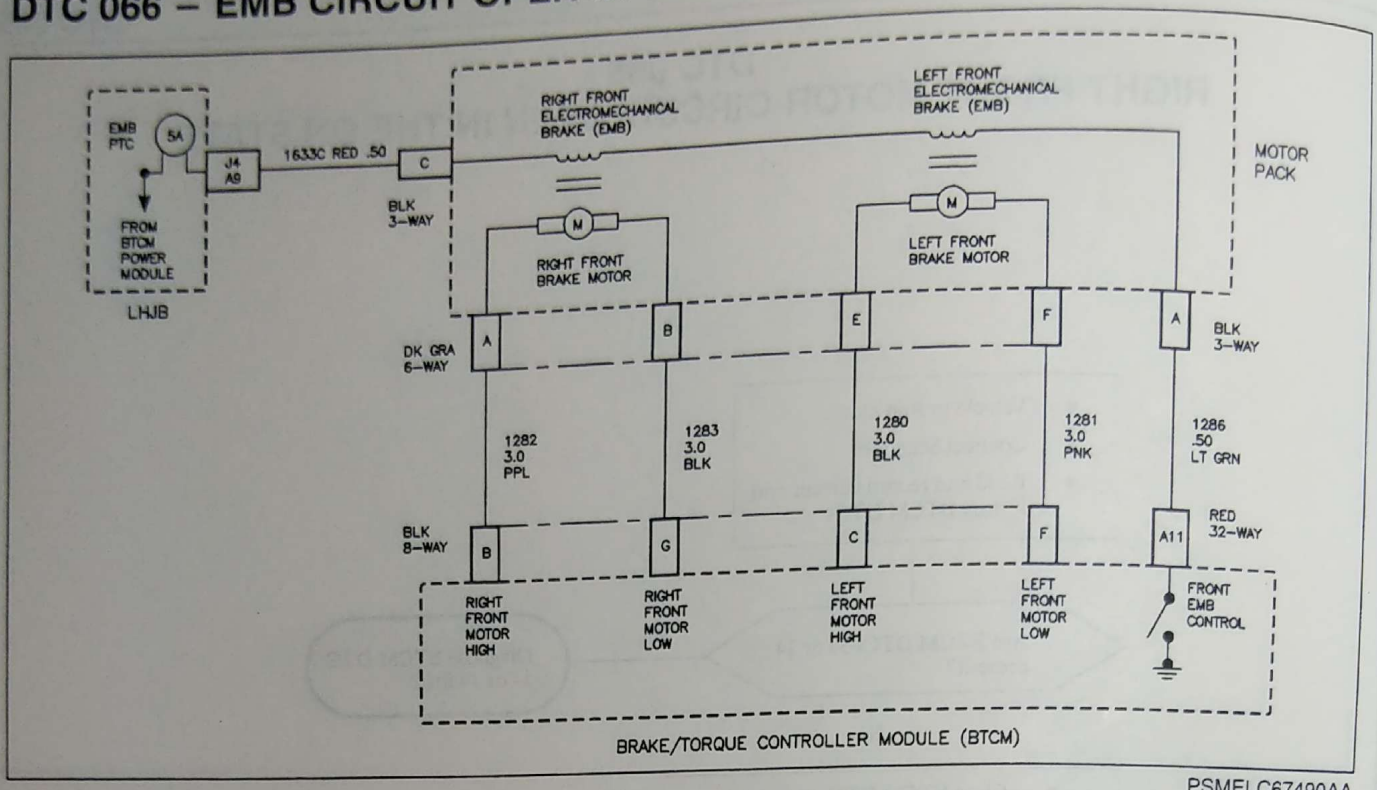
DTC 065
RIGHT FRONT MOTOR CIRCUIT OPEN IN THE ON STATE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are BTCM DTCs 54 or 74 present?
Yes
Diagnose BTCM DTC 54 or 74 first.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Depress brake pedal for a few seconds, then release.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Call technical assistance.

DTC 066 – EMB CIRCUIT OPEN IN THE ON STATE



PSMELC67490AA

EMB CIRCUIT OPEN IN THE ON STATE

The brake torque control module (BTCM) constantly monitors the EMB circuit voltage. This DTC is set if an open is detected in the electromagnetic brakes (EMB) circuit while the EMBs is commanded On.

DTC PARAMETERS

DTC 066 will set if:

- Open EMB circuit.
- Failed EMB (coil open or high resistance).
- Malfunctioning EMB driver circuit in the BTCM.
- Low auxiliary battery system voltage.

DTC 066 will set when:

Anytime the BTCM commands the front enable relay On and the EMBs are active. The fault exists if the feedback current from the EMB sense resistor is less than 1.4 amps while the EMBs are commanded active.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

BTCM 67

TELLTALE ILLUMINATED

BRAKE and ANTILOCK.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

Low auxiliary battery voltage (battery or APM) can cause this DTC to set. Try setting DTC in off state. If DTC only sets in off state, monitor auxiliary battery voltage while applying brakes in the Lock mode. If the voltage drops below 10 volts check the auxiliary battery per Battery and Charging service manual.

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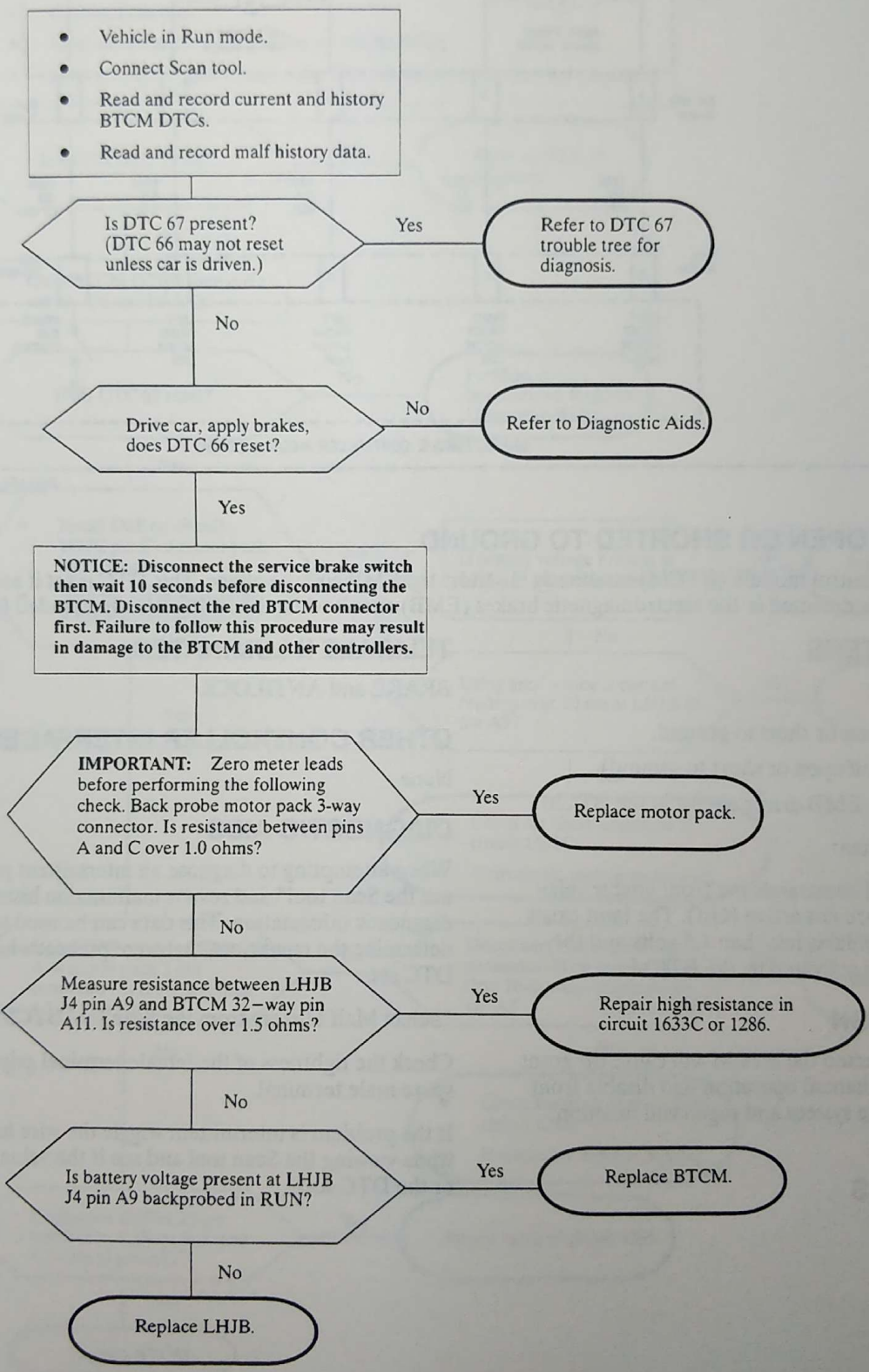
DTC 066
EMB CIRCUIT OPEN IN THE ON STATE


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record current and history BTCM DTCs.
• Read and record malf history data.
Is DTC 67 present? (DTC 66 may not reset unless car is driven.)
Yes
Refer to DTC 67 trouble tree for diagnosis.
No
Drive car, apply brakes, does DTC 66 reset?
No
Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
IMPORTANT: Zero meter leads before performing the following check. Back probe motor pack 3-way connector. Is resistance between pins A and C over 1.0 ohms?
Yes
Replace motor pack.
No
Measure resistance between LHJB J4 pin A9 and BTCM 32−way pin A11. Is resistance over 1.5 ohms?
Yes
Repair high resistance in circuit 1633C or 1286.
No
Is battery voltage present at LHJB J4 pin A9 backprobed in RUN?
Yes
Replace BTCM.
No
Replace LHJB.

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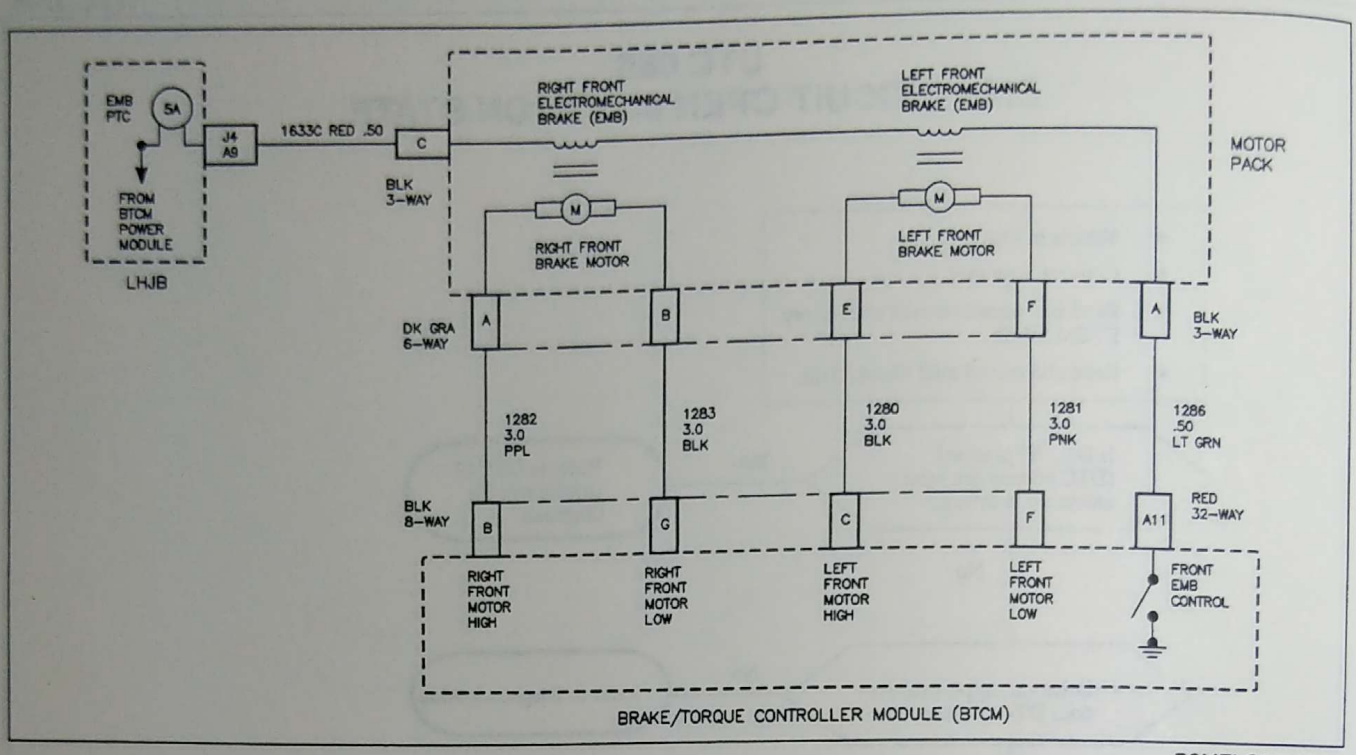
DTC 067 – EMB CIRCUIT OPEN OR SHORTED TO GROUND



PSMELC67490AA

EMB CIRCUIT OPEN OR SHORTED TO GROUND

The brake torque control module (BTCM) constantly monitors the EMB circuit voltage. This DTC is set if an open or short to ground is detected in the electromagnetic brakes (EMB) circuit while the EMBs are commanded Off.

DTC PARAMETERS

DTC 067 will set if:

- EMB circuit open or short to ground.
- Failed EMB (coil open or short to ground).
- Malfunctioning EMB driver circuit in the BTCM.

DTC 067 will set when:

Anytime the BTCM commands the front enable relay On and the EMBs are not active (Off). The fault exists if the EMBLO terminal is less than 4.5 volts and the EMBs are not being activated by the BTCM.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

BTCM 66

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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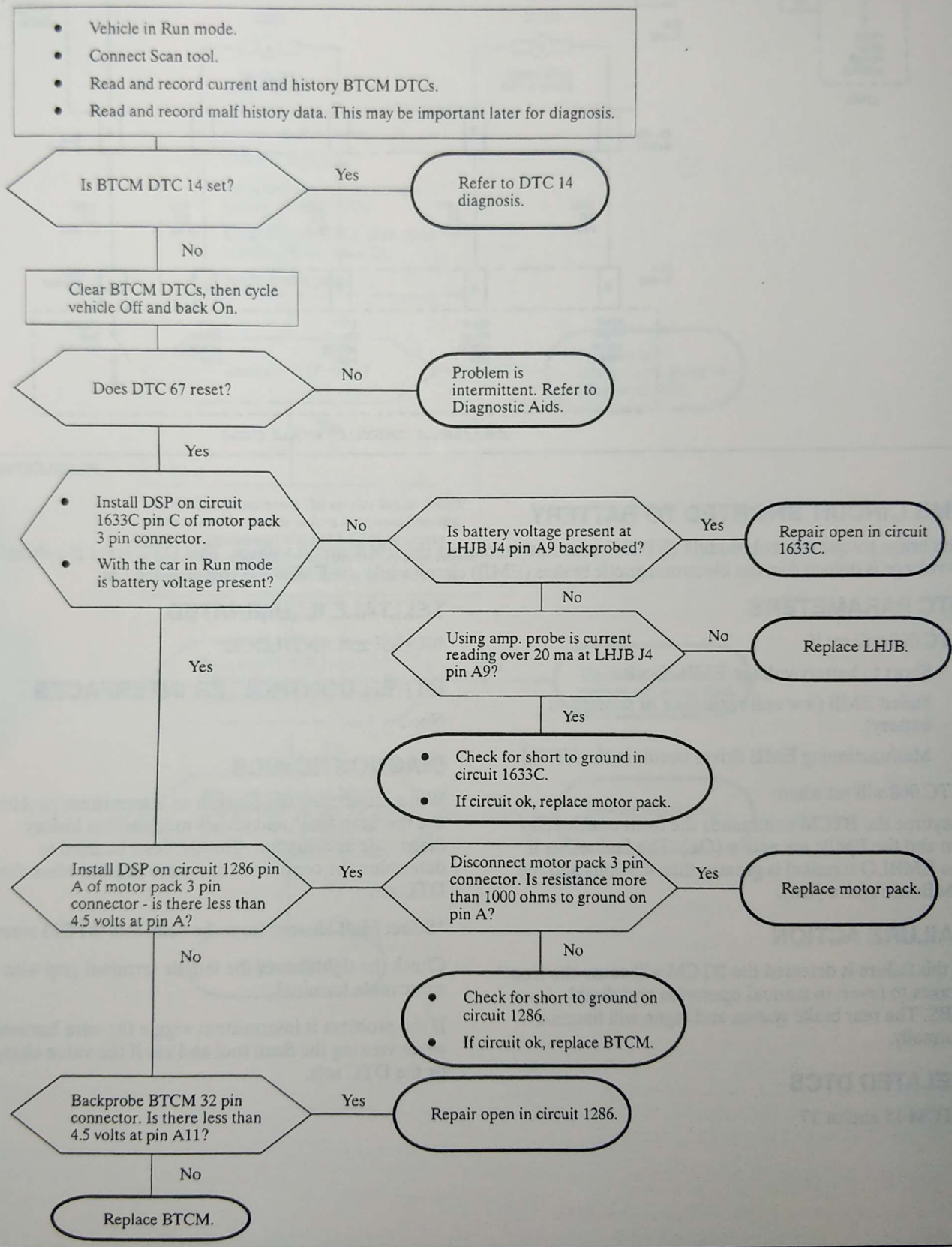
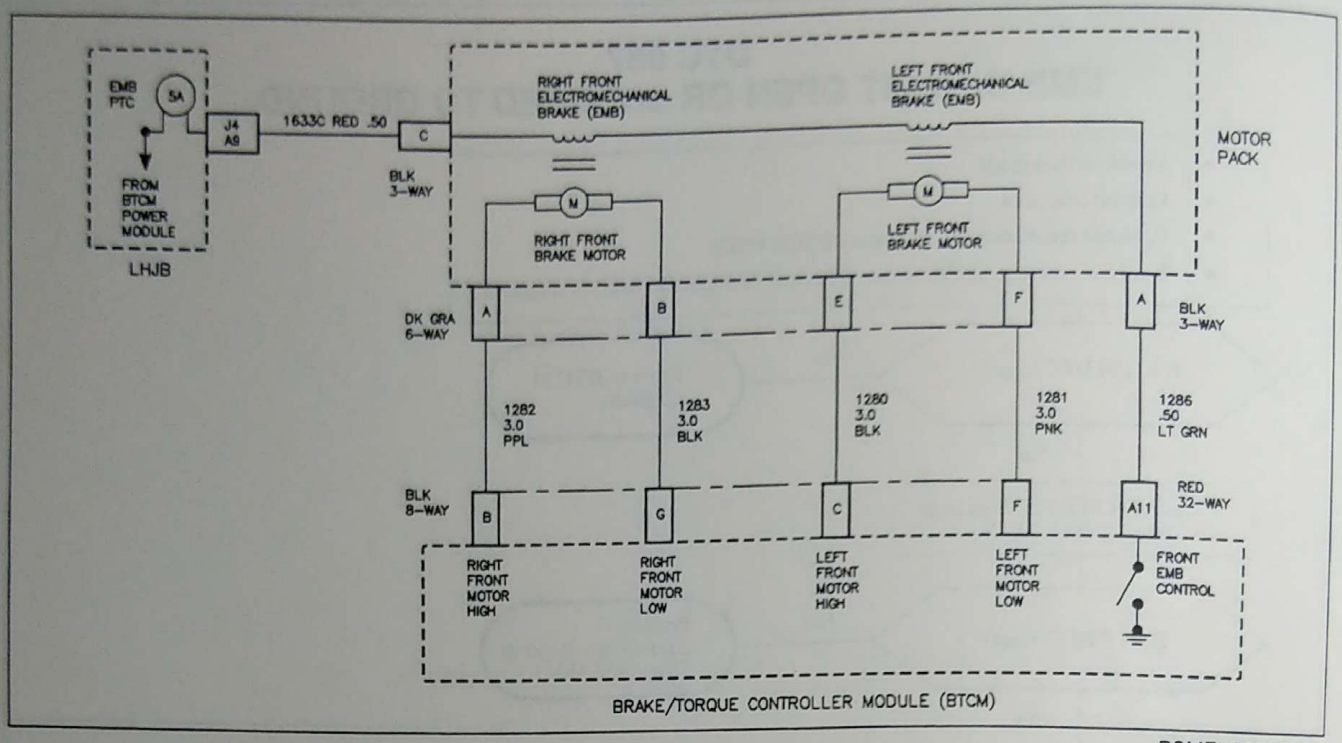
DTC 067
EMB CIRCUIT OPEN OR SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Read and record malf history data. This may be important later for diagnosis.
Is BTCM DTC 14 set?
Yes
Refer to DTC 14 diagnosis.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does DTC 67 reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Install DSP on circuit 1633C pin C of motor pack 3 pin connector.
With the car in Run mode is battery voltage present?
No
Is battery voltage present at LHJB J4 pin A9 backprobed?
Yes
Repair open in circuit 1633C.
No
Using amp. probe is current reading over 20 ma at LHJB J4 pin A9?
No
Replace LHJB.
Yes
Check for short to ground in circuit 1633C.
If circuit ok, replace motor pack.
Yes
Install DSP on circuit 1286 pin A of motor pack 3 pin connector - is there less than 4.5 volts at pin A?
Yes
Disconnect motor pack 3 pin connector. Is resistance more than 1000 ohms to ground on pin A?
Yes
Replace motor pack.
No
No
Check for short to ground on circuit 1286.
If circuit ok, replace BTCM.
Backprobe BTCM 32 pin connector. Is there less than 4.5 volts at pin A11?
Yes
Repair open in circuit 1286.
No
Replace BTCM.

DTC 068 – EMB CIRCUIT SHORTED TO BATTERY



PSMELC67490AA

EMB CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) constantly monitors the EMB circuit voltage. This DTC is set if a short to voltage is detected in the electromagnetic brakes (EMB) circuit while the EMBs are commanded On.

DTC PARAMETERS

DTC 068 will set if:

- Short to battery voltage EMB circuit.
- Failed EMB (low coil resistance or shorted to battery).
- Malfunctioning EMB driver circuit in the BTCM.

DTC 068 will set when:

Anytime the BTCM commands the front enable relay On and the EMBs are active (On). The fault exists if the EMBLO terminal is greater than 4.5 volts and the EMBs are active (On).

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

BTCM 15 and/or 17

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 068
EMB CIRCUIT SHORTED TO BATTERY

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.
- Apply brake pedal.

Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

Disconnect LHJB J4 connector. Is there battery voltage at BTCM 32 pin connector pin A11?

Yes → Check for short to voltage on circuit 1286.

No

Measure resistance between LHJB J4 pin A9 and BTCM 32 pin connector pin A11. Is resistance over 0.8 ohms?

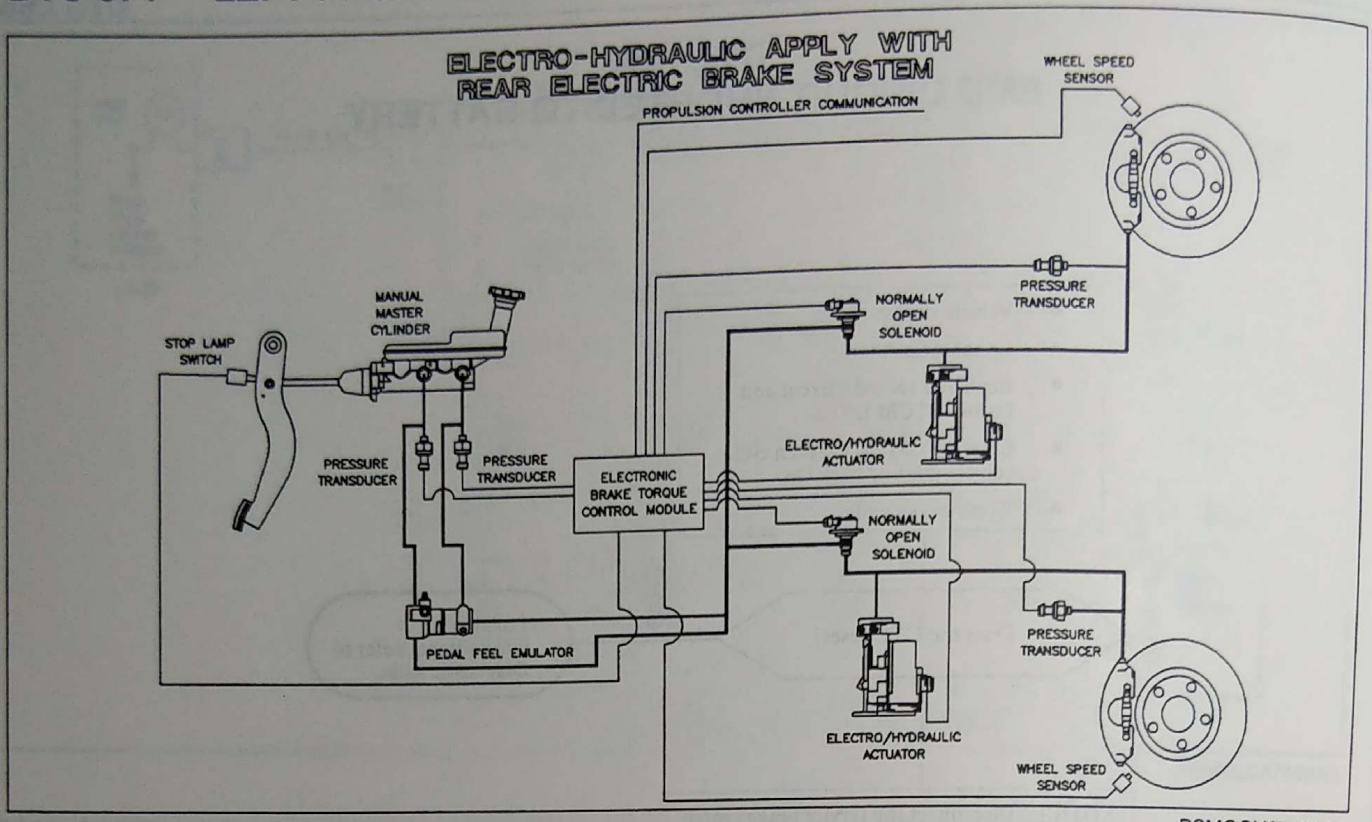
Yes → Replace motor pack.

No

Replace BTCM.

CamScanner

DTC 071 – LEFT FRONT MAXIMUM MOTOR CURRENT



PSMGCH67421AA

LEFT FRONT MAXIMUM MOTOR CURRENT

The brake torque control module (BTCM) monitors the motor current while braking. If maximum current is commanded to the motor for an excessive time this fault will be set.

DTC PARAMETERS

DTC 071 will set if:

- Malfunctioning solenoid.
- Leaking hydraulic circuit (downstream).
- Malfunctioning downstream pressure sensor.
- Downstream pressure sensor circuit fault.
- Restriction in the hydraulic circuit.
- Air in the hydraulic system.
- Malfunctioning electromagnetic brake.
- Modulator or motor pack assembly failure.
- Low auxiliary battery system voltage.

DTC 071 will set when:

Anytime the BTCM commands the front enable relay On and braking is occurring. A fault is present if a duty cycle greater than 89% is commanded to the left front motor for greater than four seconds. The 89% duty cycle results in maximum current (20 amps).

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 51, 64 and 66

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 071 – LEFT FRONT MAXIMUM MOTOR CURRENT

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- IMPORTANT: Read and record malf history data. This may be needed later in diagnosis.

Is DTC 64 present?

Yes → Replace motor pack.

No

- Clean underbody as necessary
- Inspect for pinched/damaged lines
- Use assistant or use scan tool test to maintain heavy brake pressure.
- Inspect for leaks.

Are any leaks/damaged lines present?

Yes → Repair as necessary.

No

Enter run mode and keep foot off brake during this test. In scan tool BTCM general info check LFPS SENSE, and RFPS SENSE. Are all four pressure sensors reading between 0.42 and 0.58 volts?

No → Replace sensor outside of range.

Yes

On scan tool watch LFPS while maintaining firm, steady pressure on the brake pedal - does the pressure drop more than 100 psi/min or does the pedal push back against your foot (the first time you apply the brake after going to RUN)? To repeat condition select OFF/ACC then RUN again.

Yes → Replace left solenoid.

No

Bleed system.

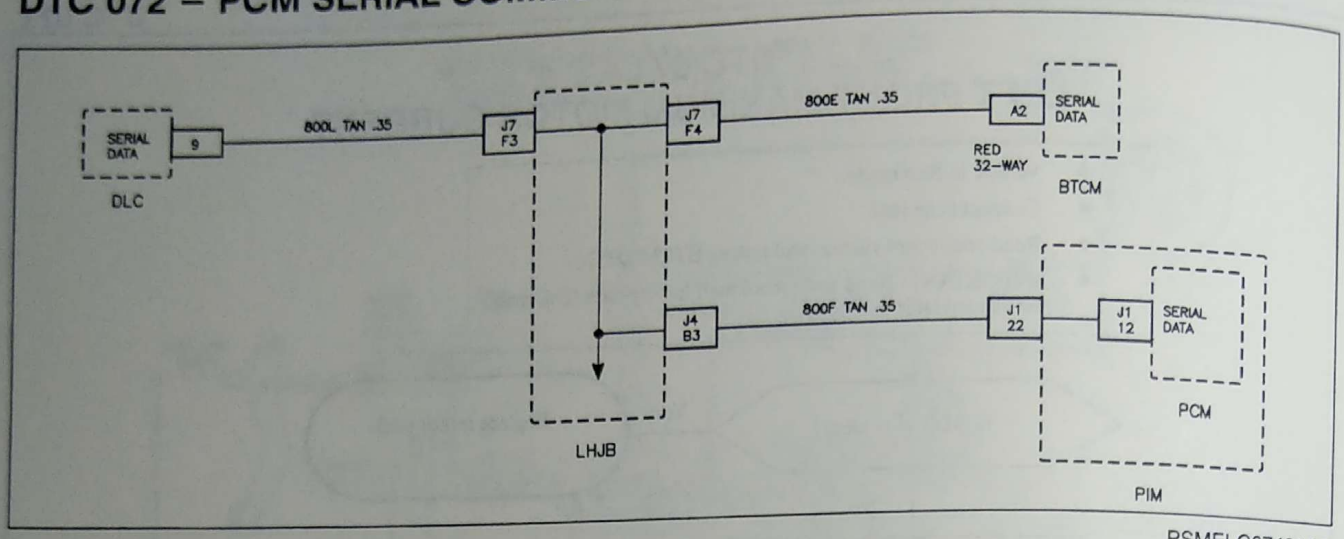
Drive vehicle and perform several stops.

If DTC 71 resets replace motor pack.

IMPORTANT: Follow motor pack, Brake Pressure Modulator Valve R and R procedure in this manual to avoid false DTC resetting and misdiagnosis.

CamScanner

DTC 072 – PCM SERIAL COMMUNICATION FAILURE



PSMELC67491AA

PCM SERIAL COMMUNICATION FAILURE

The brake torque control module (BTCM) receives information from the PCM over the serial data line. This information is used to determine regen achieved status and to implement conserve energy operation.

DTC PARAMETERS

DTC 072 will set if:

- The serial data (UART) line is shorted to ground, battery or open.
- The PCM is not responding.

DTC 072 will set when:

Run 1 is present. If the BTCM does not receive any communication from the PCM for eight seconds, this DTC will be set.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

None

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

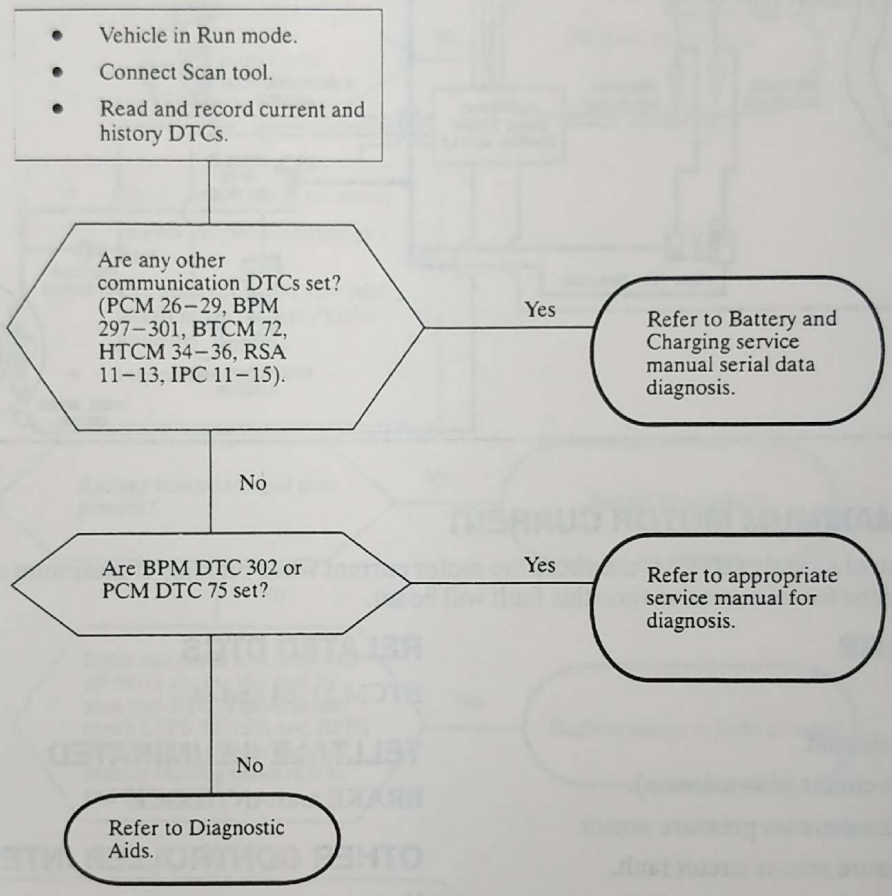
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

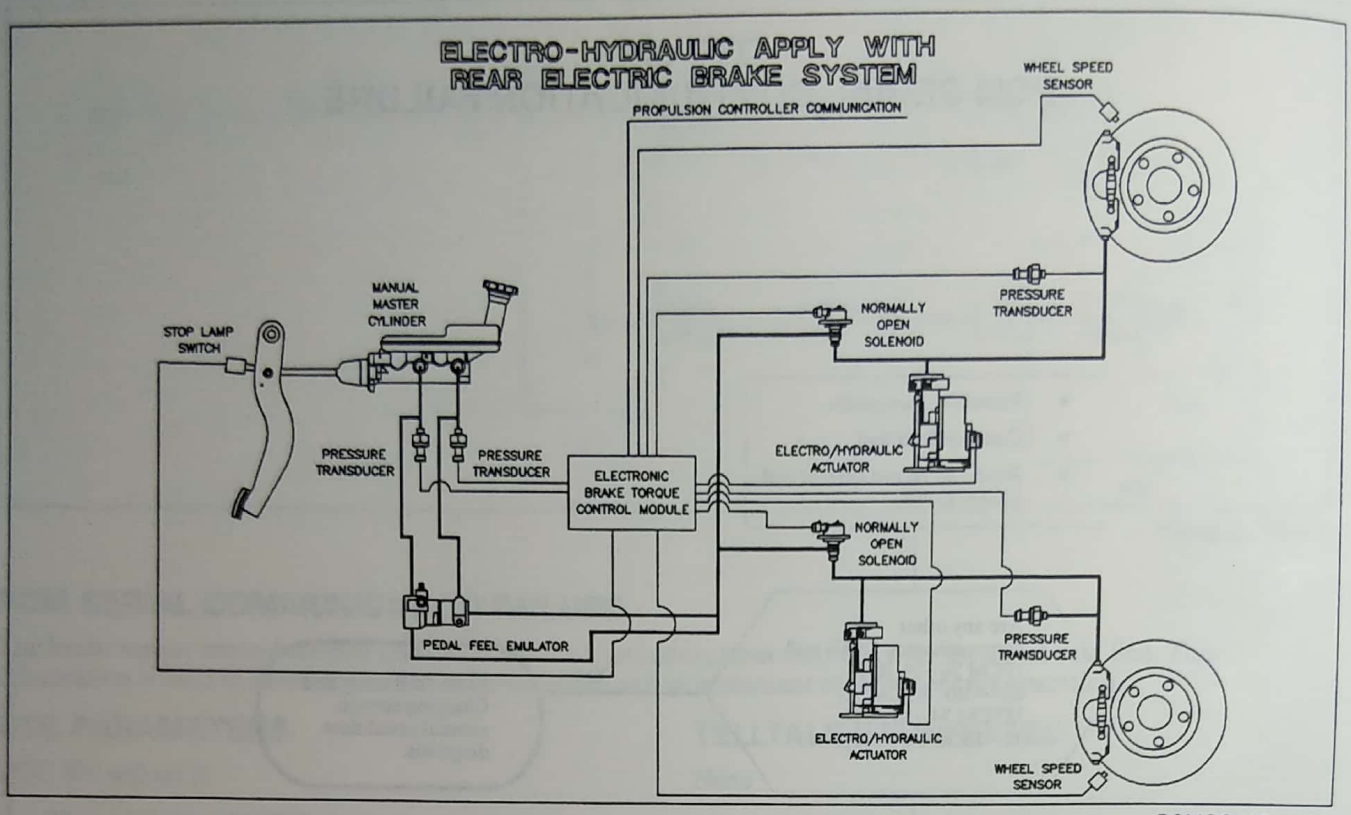
If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 072
PCM SERIAL COMMUNICATION FAILURE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history DTCs.
Are any other communication DTCs set? (PCM 26−29, BPM 297−301, BTCM 72, HTCM 34−36, RSA 11−13, IPC 11−15).
Yes
Refer to Battery and Charging service manual serial data diagnosis.
No
Are BPM DTC 302 or PCM DTC 75 set?
Yes
Refer to appropriate service manual for diagnosis.
No
Refer to Diagnostic Aids.

CamScanner

DTC 074 – RIGHT FRONT MAXIMUM MOTOR CURRENT



PSMGCH67421AA

RIGHT FRONT MAXIMUM MOTOR CURRENT

The brake torque control module (BTCM) monitors the motor current while braking. If maximum current is commanded to the motor for an excessive time this fault will be set.

DTC PARAMETERS

DTC 074 will set if:

- Malfunctioning solenoid.
- Leaking hydraulic circuit (downstream).
- Malfunctioning downstream pressure sensor.
- Downstream pressure sensor circuit fault.
- Restriction in the hydraulic circuit.
- Air in the hydraulic system.
- Malfunctioning electromagnetic brake.
- Modulator or motor pack assembly failure.
- Low auxiliary battery system voltage.

DTC 074 will set when:

Anytime the BTCM commands the front enable relay On and braking is occurring. A fault is present if a duty cycle greater than 89% is commanded to the right front motor for greater than four seconds. The 89% duty cycle results in maximum current (20 amps).

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 51, 64 and 66

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 074
RIGHT FRONT MAXIMUM MOTOR CURRENT

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.

IMPORTANT: Read and record malf history data. This may be needed later in diagnosis.

Is DTC 65 present?

Yes → Replace motor pack.

No

- Clean underbody as necessary
- Inspect for pinched/damaged lines
- Use assistant or use scan tool test to maintain heavy brake pressure.
- Inspect for leaks.

Are any leaks/damaged lines present?

Yes → Repair as necessary.

No

Enter run mode and keep foot off brake during this test. In scan tool BTCM general info check LFPS SENSE, and RFPS SENSE. Are all four pressure sensors reading between 0.42 and 0.58 volts?

No → Replace sensor outside of range.

Yes

On scan tool watch RFPS while maintaining firm, steady pressure on the brake pedal - does the pressure drop more than 100 psi/min or does the pedal push back against your foot (the first time you apply the brake after going to RUN)? To repeat condition select OFF/ACC then RUN again.

Yes → Replace right solenoid.

No

Bleed system.

Drive vehicle and perform several stops.

If DTC 74 resets, replace motor pack.

IMPORTANT: Follow motor pack, Brake Pressure Modulator Valve R and R procedure in this manual to avoid false DTC resetting and misdiagnosis.

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DTC 075 – SOLENOID DRIVER FAULT

If the brake torque control module (BTCM) detects a fault with the solenoid driver chip it will disable front ABS and front power assist base brakes.

DTC PARAMETERS

DTC 075 will set if:

The solenoid driver chip has failed.

DTC 075 will set when:

Any time the BTCM commands the front enable relay On.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 075
SOLENOID DRIVER FAULT

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

If DTC 75 is set it is due to an internal BTCM fault.

Replace BTCM.

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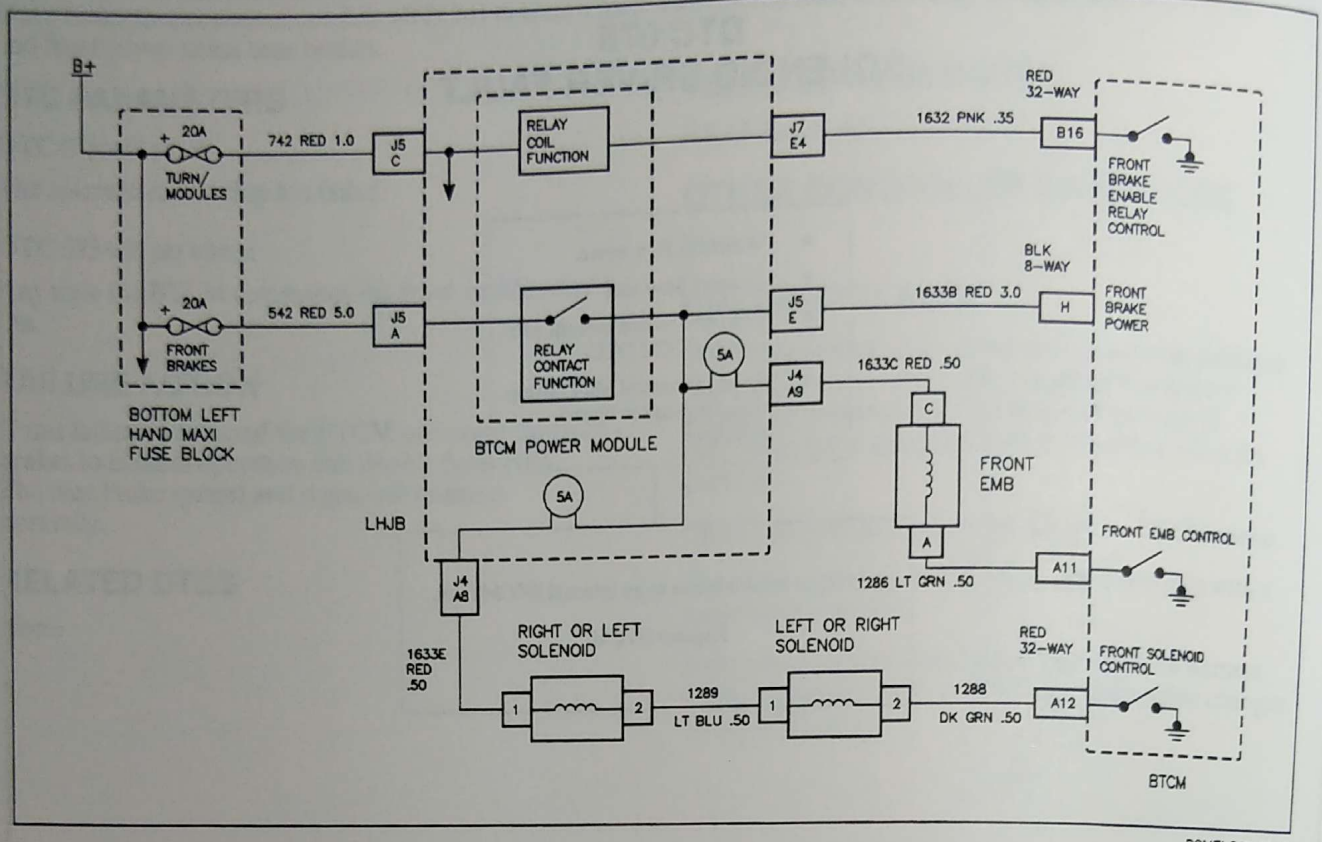
DTC 076 – SOLENOID CIRCUIT OPEN OR SHORTED TO GROUND



SOLENOID CIRCUIT OPEN OR SHORTED TO GROUND

The brake torque control module (BTCM) constantly monitors the EMB circuit voltage. This DTC is set if an open or short to ground is detected in the electromagnetic brakes (EMB) circuit while the EMBs are commanded Off.

DTC PARAMETERS

DTC 076 will set if:

- Solenoid circuitry is open or shorted to ground.
- Failed solenoid (high or open coil resistance).
- Malfunctioning solenoid driver circuit in the BTCM.

DTC 076 will set when:

Anytime the BTCM commands the front enable relay On and the solenoids are in the inactive (Off) state. If voltage at solenoid low is less than 4.5 volts this DTC will be set.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

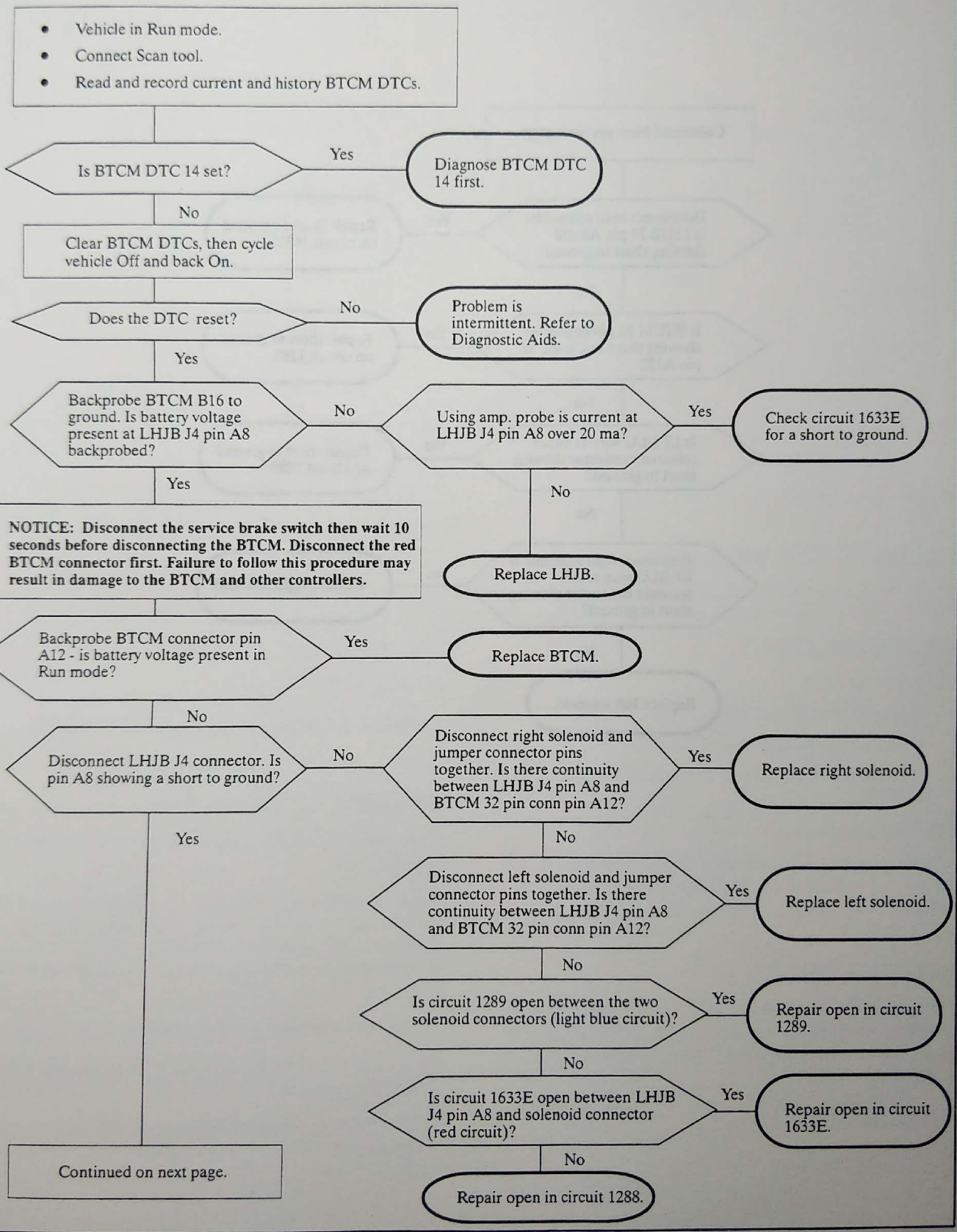
When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 076
SOLENOID CIRCUIT OPEN OR SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Is BTCM DTC 14 set?
Yes
Diagnose BTCM DTC 14 first.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Backprobe BTCM B16 to ground. Is battery voltage present at LHJB J4 pin A8 backprobed?
No
Using amp. probe is current at LHJB J4 pin A8 over 20 ma?
Yes
Check circuit 1633E for a short to ground.
Yes
No
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Replace LHJB.
Backprobe BTCM connector pin A12 - is battery voltage present in Run mode?
Yes
Replace BTCM.
No
Disconnect LHJB J4 connector. Is pin A8 showing a short to ground?
No
Disconnect right solenoid and jumper connector pins together. Is there continuity between LHJB J4 pin A8 and BTCM 32 pin conn pin A12?
Yes
Replace right solenoid.
Yes
No
Disconnect left solenoid and jumper connector pins together. Is there continuity between LHJB J4 pin A8 and BTCM 32 pin conn pin A12?
Yes
Replace left solenoid.
No
Is circuit 1289 open between the two solenoid connectors (light blue circuit)?
Yes
Repair open in circuit 1289.
No
Is circuit 1633E open between LHJB J4 pin A8 and solenoid connector (red circuit)?
Yes
Repair open in circuit 1633E.
No
Repair open in circuit 1288.
Continued on next page.

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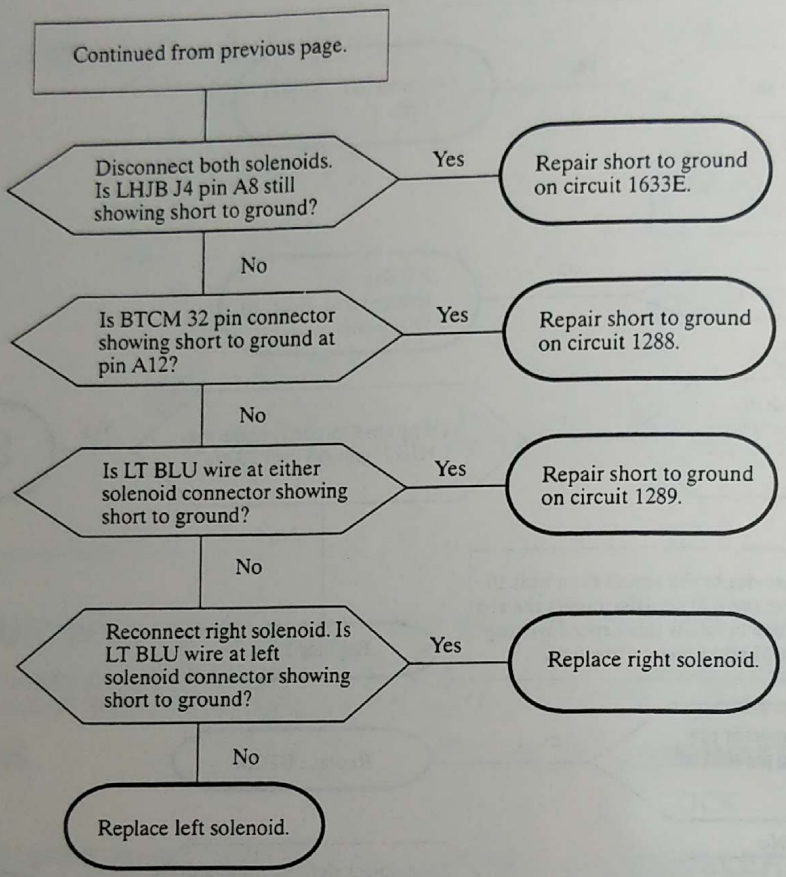
DTC 076
SOLENOID CIRCUIT OPEN OR SHORTED TO GROUND – CONTINUED


Continued from previous page.
Disconnect both solenoids. Is LHJB J4 pin A8 still showing short to ground?
Yes
Repair short to ground on circuit 1633E.
No
Is BTCM 32 pin connector showing short to ground at pin A12?
Yes
Repair short to ground on circuit 1288.
No
Is LT BLU wire at either solenoid connector showing short to ground?
Yes
Repair short to ground on circuit 1289.
No
Reconnect right solenoid. Is LT BLU wire at left solenoid connector showing short to ground?
Yes
Replace right solenoid.
No
Replace left solenoid.

NOTES

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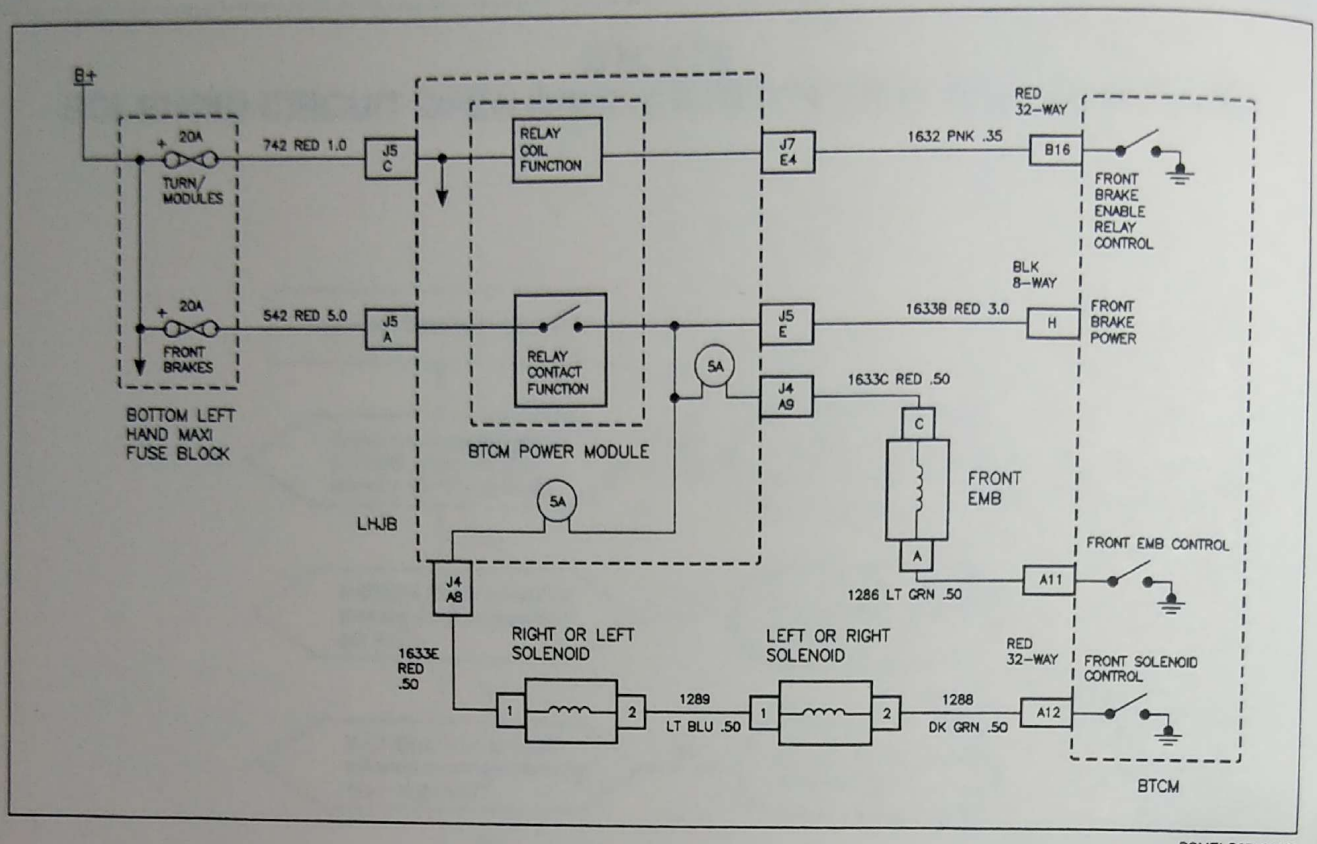
DTC 077 – SOLENOID CIRCUIT SHORTED TO BATTERY VOLTAGE



PSMELC67483AC

SOLENOID CIRCUIT SHORTED TO BATTERY VOLTAGE

The brake torque control module (BTCM) constantly monitors the EMB circuit voltage. This DTC is set if an open or short to ground is detected in the electromagnetic brakes (EMB) circuit while the EMBs are commanded Off.

DTC PARAMETERS

DTC 077 will set if:

- Solenoid circuit shorted to battery voltage.
- Failed solenoid (low coil resistance).
- Malfunctioning solenoid driver circuit in the BTCM.

DTC 077 will set when:

Anytime the BTCM commands the front enable relay On and the solenoids are in the active (On) state. If voltage at solenoid low is greater than 4.5 volts this DTC will be set.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

BTCM 15 and/or 17.

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

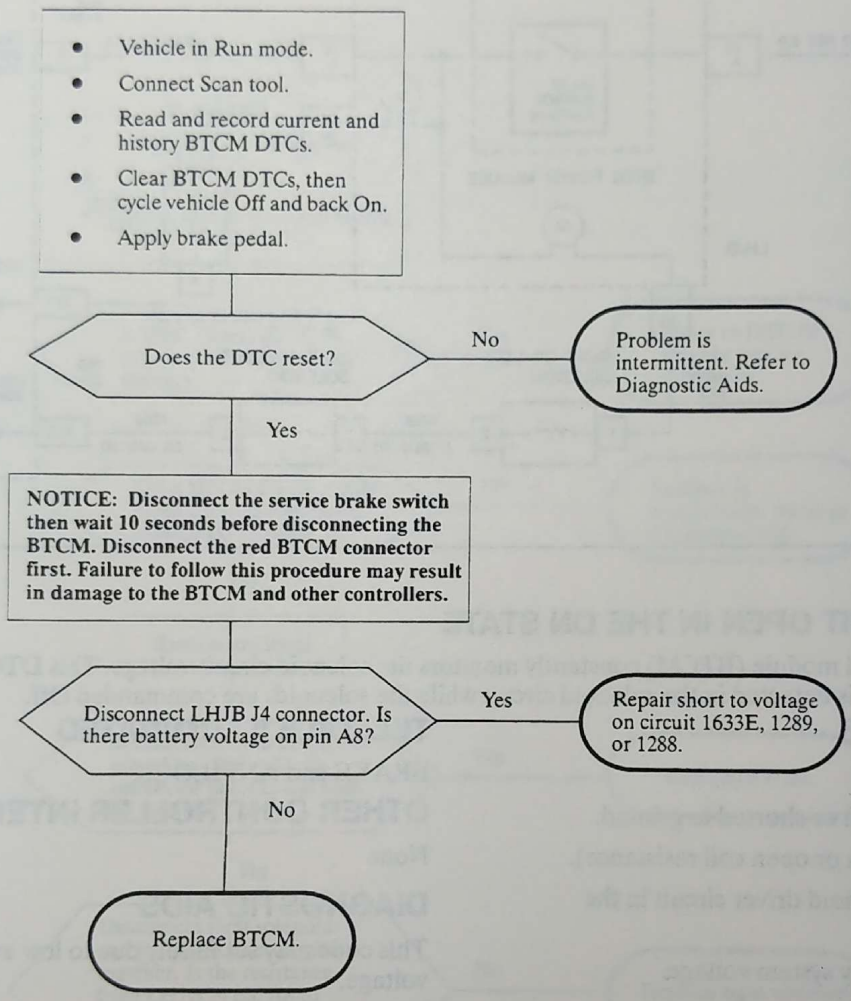
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

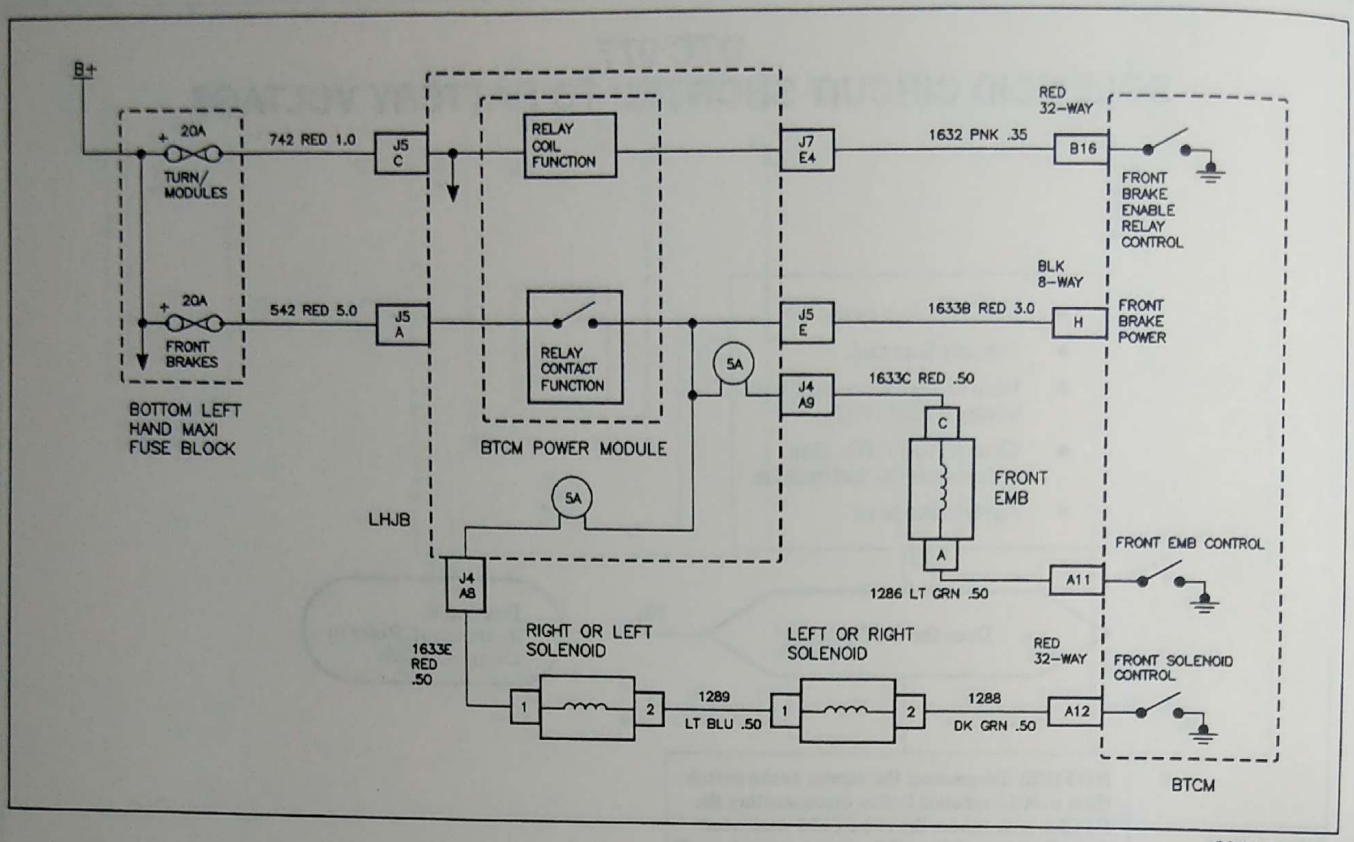
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 077
SOLENOID CIRCUIT SHORTED TO BATTERY VOLTAGE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Apply brake pedal.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Disconnect LHJB J4 connector. Is there battery voltage on pin A8?
Yes
Repair short to voltage on circuit 1633E, 1289, or 1288.
No
Replace BTCM.

DTC 078 – SOLENOID CIRCUIT OPEN IN THE ON STATE



PSMELC67483AC

SOLENOID CIRCUIT OPEN IN THE ON STATE

The brake torque control module (BTCM) constantly monitors the solenoid circuit voltage. This DTC is set if an open or short to ground is detected in the solenoid circuit while the solenoids are commanded Off.

DTC PARAMETERS

DTC 078 will set if:

- Solenoid circuit open or shorted to ground.
- Failed solenoid (high or open coil resistance).
- Malfunctioning solenoid driver circuit in the BTCM.
- Low auxilliary battery system voltage.

DTC 078 will set when:

Anytime the BTCM commands the front enable relay On and the solenoids are in the active (On) state. The fault exists if the feedback current from the solenoids sense resistor is less than 1.3 amps while the solenoids are active.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

BTCM 076

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

Solenoids should each read between 0.4 and 1.0 ohms. Low auxiliary battery voltage (battery or APM) can cause this DTC to set. Try setting DTC in off state. If DTC only sets in off state monitor auxiliary battery voltage while applying brakes in the Lock mode. If the voltage drops below 10 volts check the auxiliary battery per Battery and Charging service manual.

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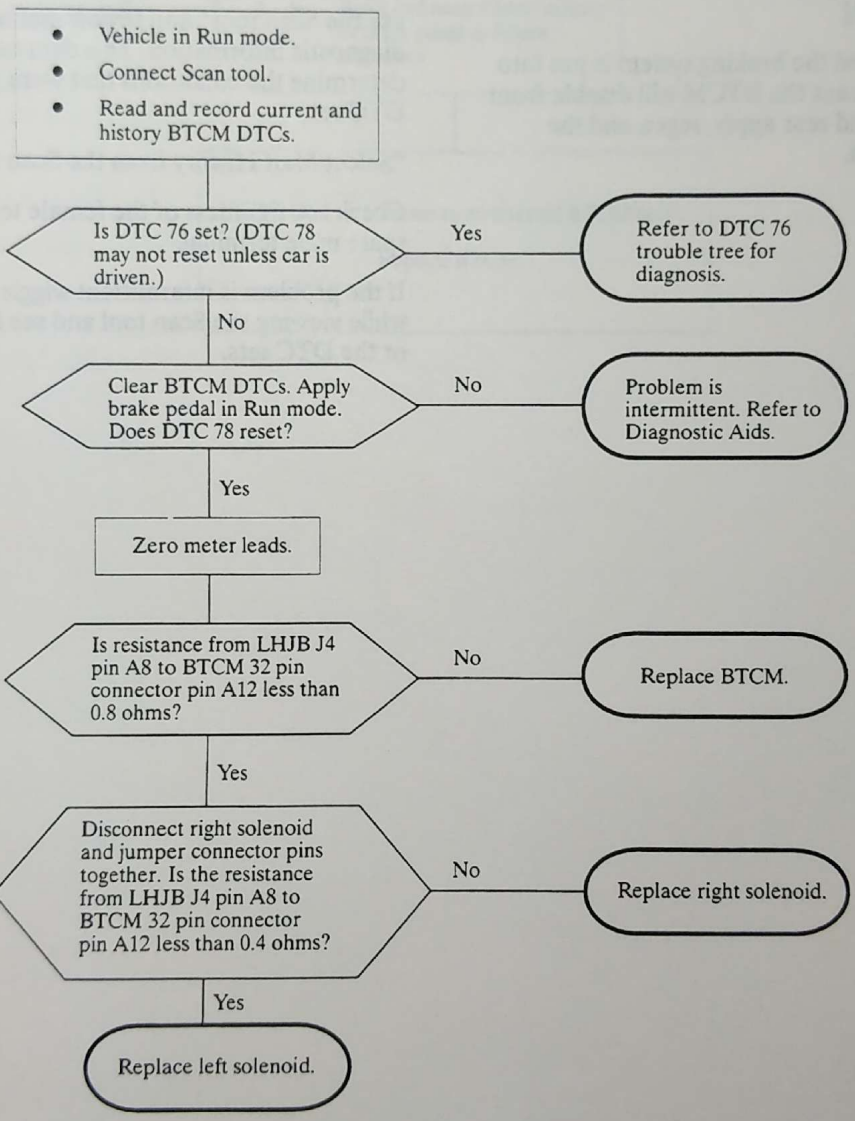
DTC 078
SOLENOID CIRCUIT OPEN IN THE ON STATE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Is DTC 76 set? (DTC 78 may not reset unless car is driven.)
Yes
Refer to DTC 76 trouble tree for diagnosis.
No
Clear BTCM DTCs. Apply brake pedal in Run mode. Does DTC 78 reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Zero meter leads.
Is resistance from LHJB J4 pin A8 to BTCM 32 pin connector pin A12 less than 0.8 ohms?
No
Replace BTCM.
Yes
Disconnect right solenoid and jumper connector pins together. Is the resistance from LHJB J4 pin A8 to BTCM 32 pin connector pin A12 less than 0.4 ohms?
No
Replace right solenoid.
Yes
Replace left solenoid.

CamScanner

DTC 081 – RAM CHECK FAILURE

If the brake torque control module (BTCM) fails its internal random access memory (RAM) test it will disable front and rear ABS, front power assist, rear apply and the traction control system.

DTC PARAMETERS

DTC 083 will set if:

- The BTCMs internal RAM memory check fails (internal BTCM failure).

DTC 081 will set when:

Anytime the BTCM is powered up.

FAILURE ACTION

If this failure is detected the braking system is put into manual mode. This means the BTCM will disable front and rear ABS, front and rear apply, regen and the traction control system.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 081
RAM CHECK FAILURE

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

If DTC 81 is set it is due to an internal BTCM fault.

Replace BTCM.

CamScanner

DTC 082 – EEPROM CHECKSUM FAILURE

If the brake torque control module (BTCM) fails its internal electronically erasable programmable read only memory (EEPROM) test it will disable front and rear ABS, front power assist, rear apply and the traction control system.

DTC PARAMETERS

DTC 082 will set if:

- A service BTCM has not been correctly programmed.
- The BTCM calibrations are incorrect.
- The BTCMs internal EEPROM memory check fails (internal BTCM failure).

DTC 082 will set when:

Anytime the BTCM is powered up.

FAILURE ACTION

If this failure is detected the braking system is put into manual mode. This means the BTCM will disable front and rear ABS, front and rear apply, regen and the traction control system (TCS).

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

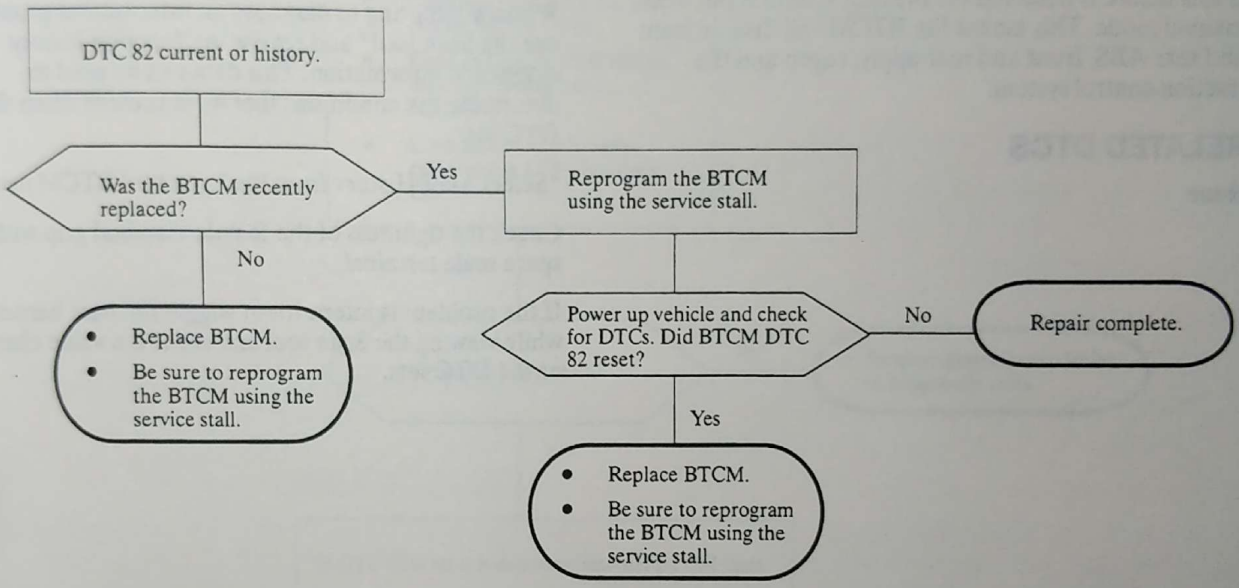
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

CamScanner

DTC 082
EEPROM CHECKSUM FAILURE


DTC 82 current or history.
Was the BTCM recently replaced?
Yes
Reprogram the BTCM using the service stall.
No
Power up vehicle and check for DTCs. Did BTCM DTC 82 reset?
No
Repair complete.
Yes
Replace BTCM.
Be sure to reprogram the BTCM using the service stall.
Replace BTCM.
Be sure to reprogram the BTCM using the service stall.

DTC 083 – ROM CHECKSUM FAILURE

If the brake torque control module (BTCM) fails its internal read only memory (ROM) test it will disable front and rear ABS, front power assist, rear apply and the Traction Control System.

DTC PARAMETERS

DTC 083 will set if:

The BTCMs internal ROM memory check fails (internal BTCM failure).

DTC 083 will set when:

Any time the BTCM is powered up.

FAILURE ACTION

If this failure is detected the braking system is put into manual mode. This means the BTCM will disable front and rear ABS, front and rear apply, regen and the traction control system.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

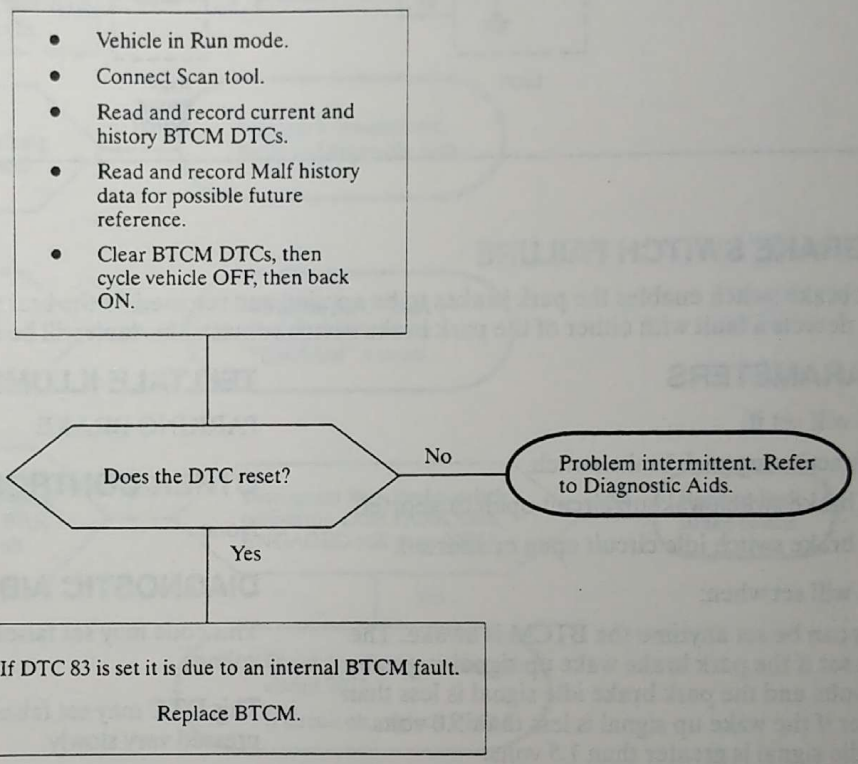
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

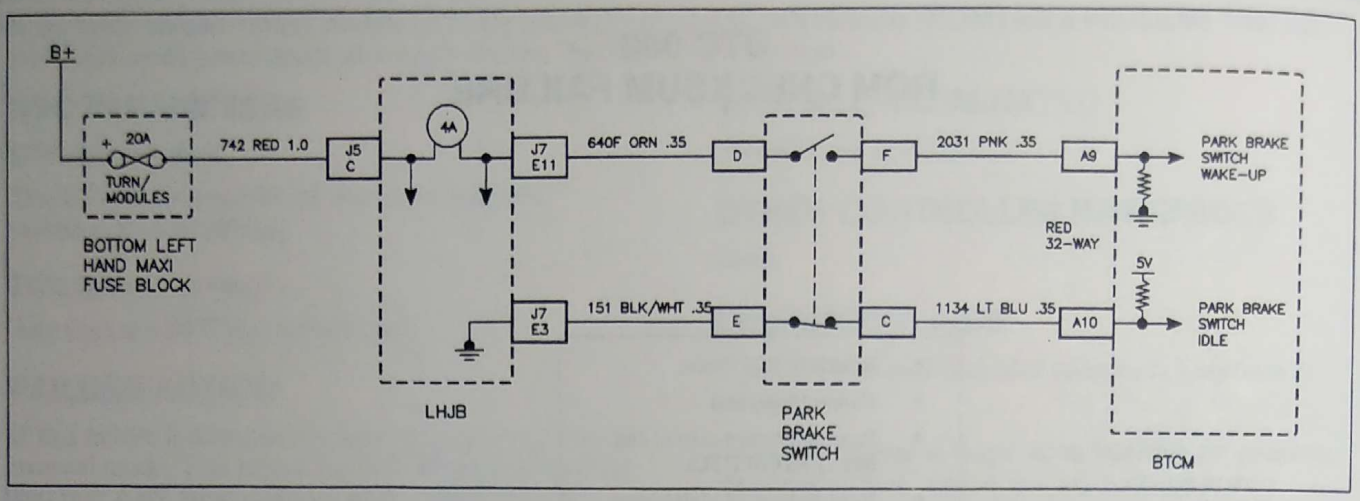
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 083
ROM CHECKSUM FAILURE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Read and record Malf history data for possible future reference.
Clear BTCM DTCs, then cycle vehicle OFF, then back ON.
Does the DTC reset?
No
Problem intermittent. Refer to Diagnostic Aids.
Yes
If DTC 83 is set it is due to an internal BTCM fault.
Replace BTCM.

DTC 084 – PARK BRAKE SWITCH FAILURE



PSMELC67492AB

PARK BRAKE SWITCH FAILURE

The park brake switch enables the park brakes to be applied and released. If the brake torque control module (BTCM) detects a fault with either of the park brake switch contacts this fault will be set.

DTC PARAMETERS

DTC 084 will set if:

- Malfunctioning park brake switch.
- Park brake switch wakeup circuit open or shorted.
- Park brake switch idle circuit open or shorted.

DTC 084 will set when:

This fault can be set anytime the BTCM is awake. The DTC will set if the park brake wake up signal is greater than 5.0 volts and the park brake idle signal is less than 1.5 volts or if the wake up signal is less than 5.0 volts and the idle signal is greater than 1.5 volts.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally except for the ability to latch or unlatch the park brake with the park brake switch.

RELATED DTCS

None

TELLTALE ILLUMINATED

PARKING BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

This DTC may set falsely if the park brake switch is pressed very slowly.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 084
PARK BRAKE SWITCH FAILURE

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Apply and release the parking brake. Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

Is instrument panel cluster blank?

Yes → Refer to "IPC Chart 1 - IPC BLANK" in the "Electrical" manual.

No

Using scan tool in EV scanner mode select BTCM and general information. Does PARK BRK ENGAGED show YES with brake released?

Yes → Disconnect Park Brake switch connector. Does PARK BRK ENGAGED still show YES?

No → Replace Park Brake switch.

Yes

- Check for short to voltage on circuit 2031.
- If circuit ok, replace BTCM.

No

Apply the parking switch - does PARK BRK ENGAGED show YES now?

No → Disconnect Park Brake switch connector. Is battery voltage present at pin D?

No

- Check for open in circuit 640 between park brake switch and LHJB.
- If circuit ok, replace LHJB.

Yes

Yes

Jumper pins D and F of Park Brake switch connector. Does PARK BRK ENGAGED now show YES?

Yes → Replace Park Brake switch.

No

- Check for open in circuit 2031.
- If circuit ok, replace BTCM.

Continued on next page

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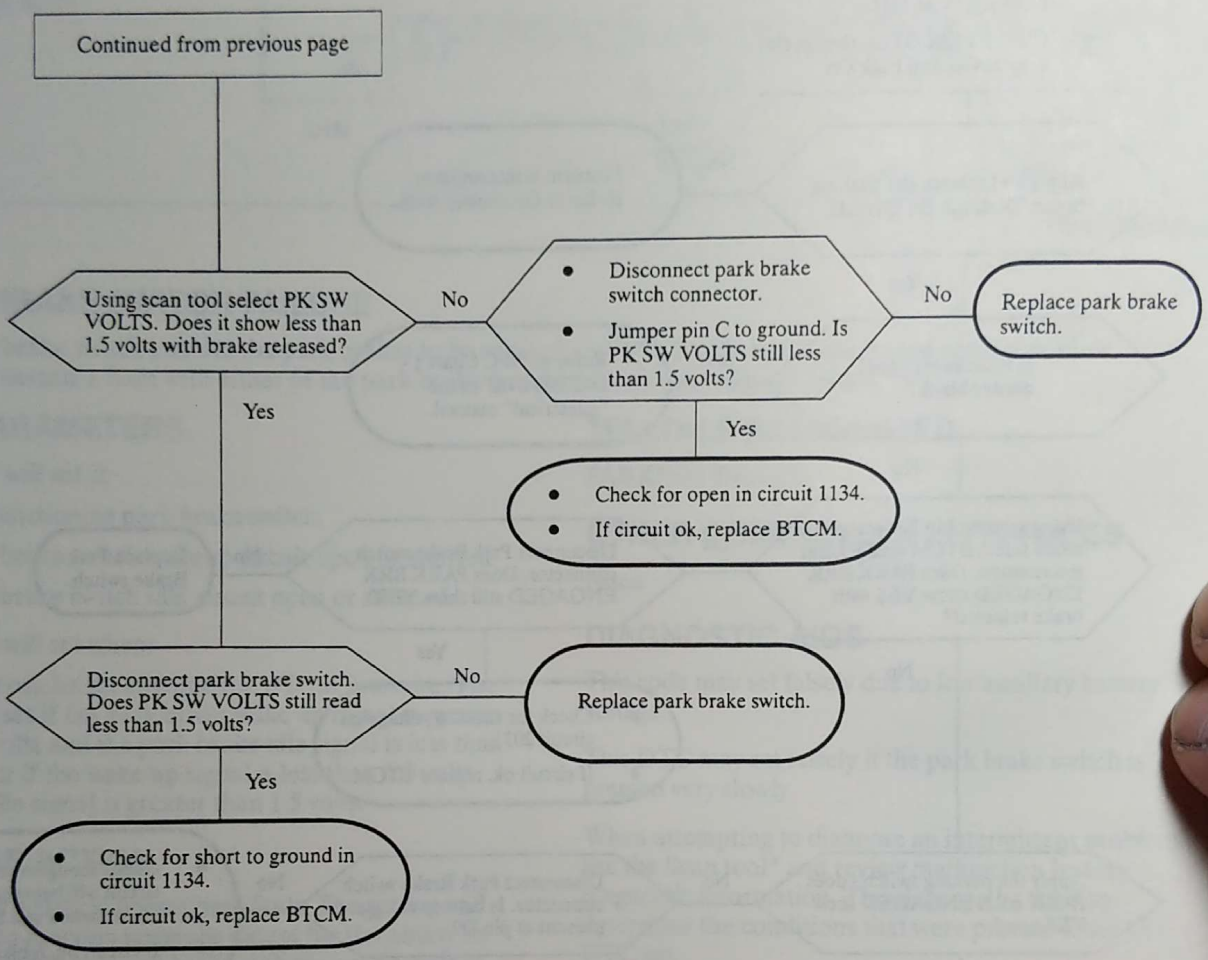
DTC 084
PARK BRAKE SWITCH FAILURE – CONTINUED


Continued from previous page
Using scan tool select PK SW VOLTS. Does it show less than 1.5 volts with brake released?
No
Disconnect park brake switch connector.
Jumper pin C to ground. Is PK SW VOLTS still less than 1.5 volts?
No
Replace park brake switch.
Yes
Yes
Check for open in circuit 1134.
If circuit ok, replace BTCM.
Disconnect park brake switch. Does PK SW VOLTS still read less than 1.5 volts?
No
Replace park brake switch.
Yes
Check for short to ground in circuit 1134.
If circuit ok, replace BTCM.

NOTES

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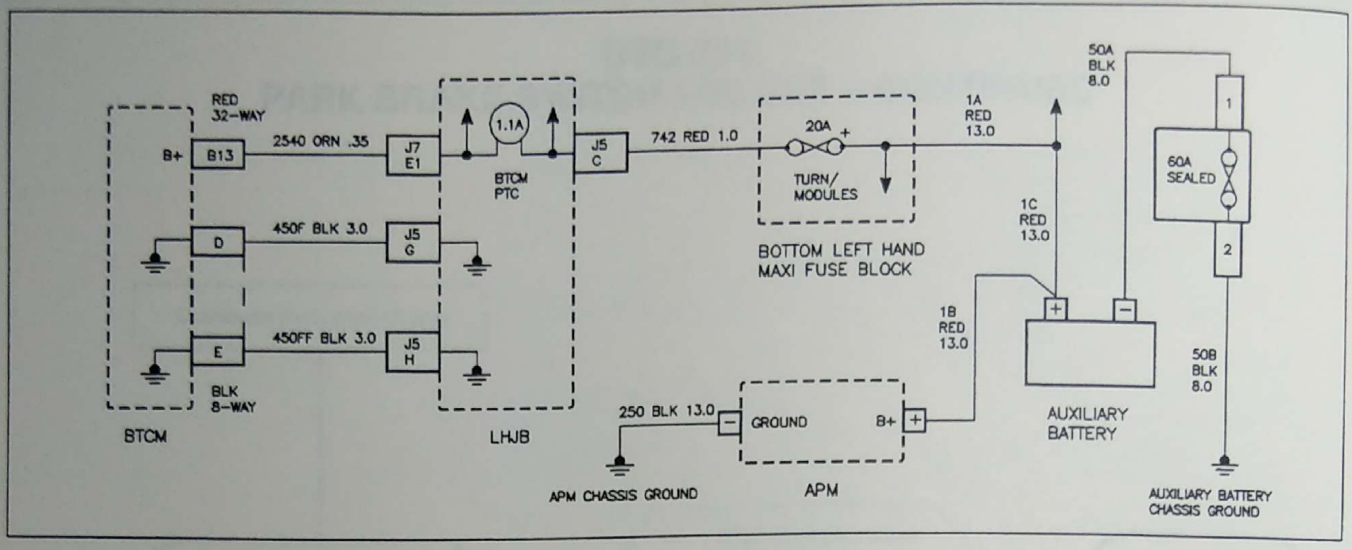
DTC 086 – RUNNING RESET FAILURE



PSMELC67493AAG

RUNNING RESET FAILURE

If the brake torque control module (BTCM) enters its initialization routine unexpectedly this DTC will be set. This will always be an intermittent failure.

DTC PARAMETERS

DTC 086 will set if:

- Intermittent battery supply to the BTCM.
- Intermittent ground supply to the BTCM.
- High frequency noise on the wheel speed sensor input(s).
- High frequency noise on the regen achieved input.
- High frequency noise on the universal asychronous receiver transmitter (UART) line.

DTC 086 will set when:

Anytime the BTCM is powered up. The DTC will set if the brake torque control module enters its initialization routine due to either a reset or a normal power up without performing the normal shutdown process before the initialization begins. This fault will also set if the vehicle speed is greater than 5 km/h (3 mph) at the beginning of the BTCM initialization.

This DTC will set in service if power to the BTCM is removed while powered up or within five seconds after BTCM power down.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 086
RUNNING RESET FAILURE

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

DTC 86 cannot display while the failure condition is present. This is because the BTCM will be disabled during the condition and DTCs will not be readable.

If the DTC is current it means the condition has occurred in this run cycle.

Refer to diagnostic aids to try and duplicate and diagnose the condition.

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DTC 087 – LOOPTIME OVERRUN FAILURE

If high frequency noise is introduced to the brake torque control module (BTCM) this DTC may be set.

DTC PARAMETERS

DTC 087 will set if:

- High frequency (up to 20 KHz) noise on the wheel speed sensor input(s).
- High frequency (up to 20 KHz) noise on the regen achieved input.
- High frequency (up to 20 KHz) noise on the UART line.

DTC 087 will set when:

Any time the BTCM is powered up. If the BTCM overruns its normal looptime this DTC will set.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation, disable front and rear ABS and disable traction control system (TCS). The rear brake apply and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 087
LOOPTIME OVERRUN FAILURE

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

DTC 87 should not set under field operating conditions.

Diagnosing this DTC (if set) requires special test equipment.

If DTC 87 is set contact technical assistance.

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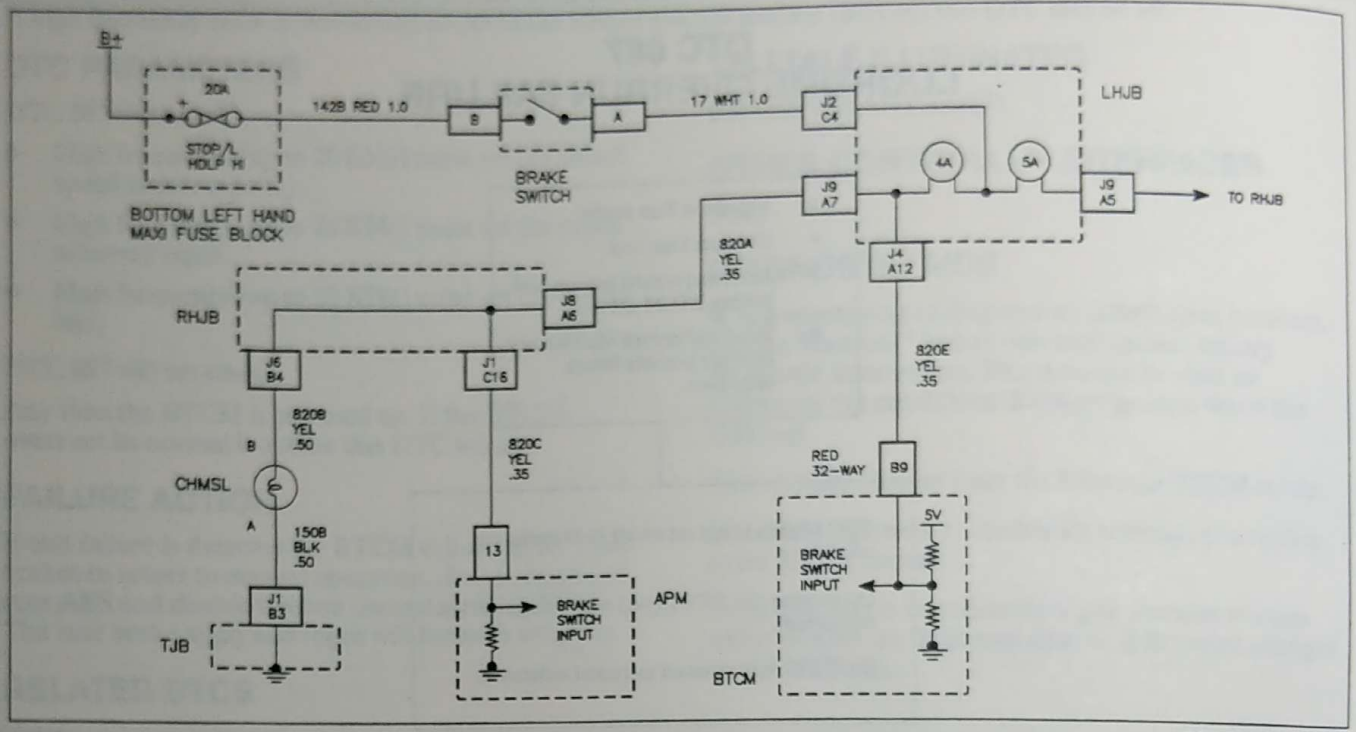
DTC 091 – BRAKE SWITCH CONTACTS OPEN



PSMELC67494AA

BRAKE SWITCH CONTACTS OPEN

If the brake switch contacts fail to close, the brake torque control module (BTCM) will still recognize a request to stop because the master cylinder pressure sensors will indicate the drivers input.

DTC PARAMETERS

DTC 091 will set if:

- Stop/L headlamp Hi fuse open.
- Brake switch failed (contacts open or plunger stuck).
- Brake switch circuits 142B or 17 open or shorted to ground.
- LHJB failure.

DTC 091 will set when:

This fault can be set anytime the BTCM is awake. The DTC will set if the brake switch if Off and the master cylinder pressure indicates driver input greater than 231 kPa (33.5 psi) for more than one second.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally. Brake pedal feel will change and the brake lights will not operate.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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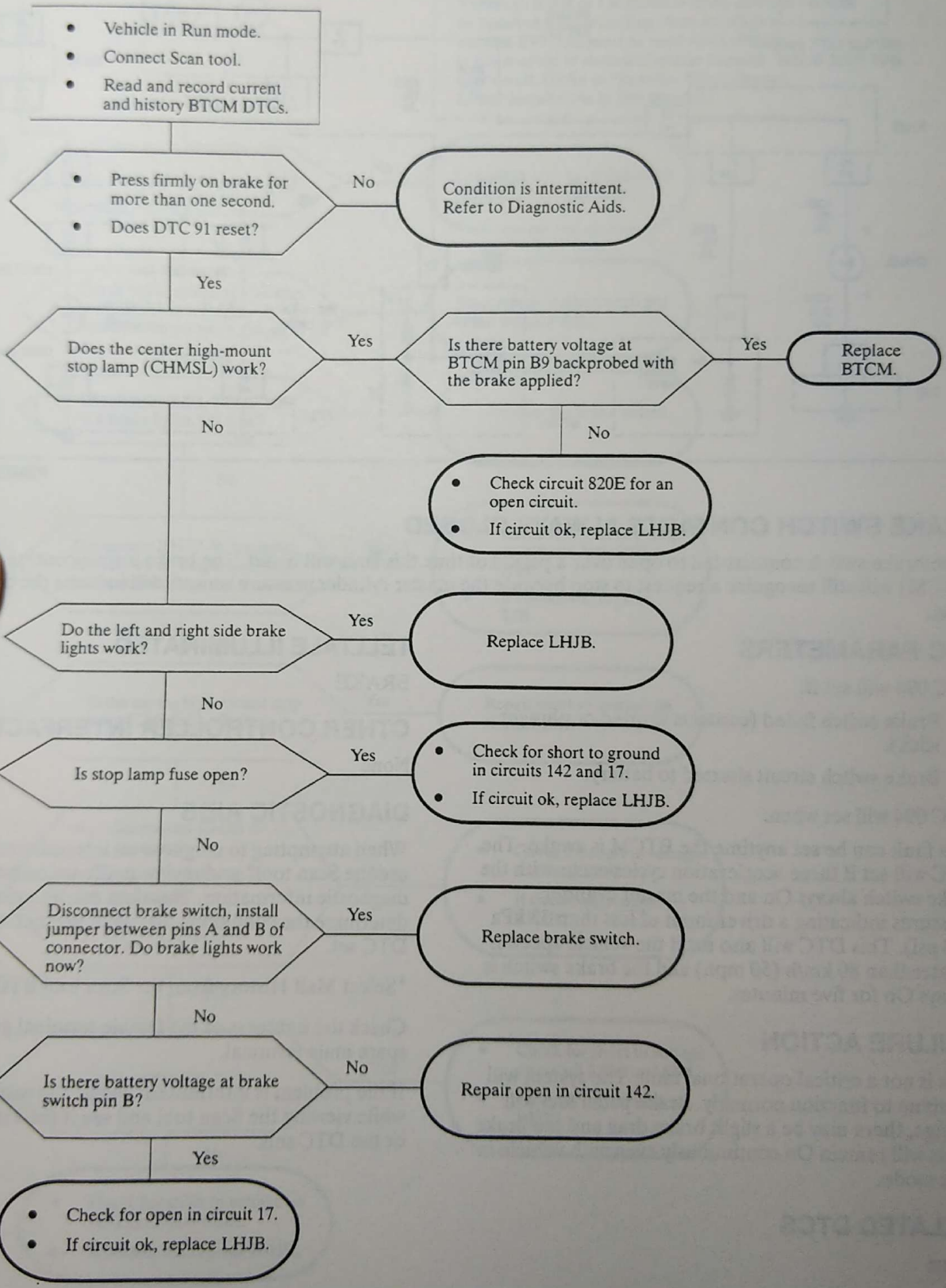
DTC 091
BRAKE SWITCH CONTACTS OPEN


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record current and history BTCM DTCs.
• Press firmly on brake for more than one second.
• Does DTC 91 reset?
No
Condition is intermittent. Refer to Diagnostic Aids.
Yes
Does the center high-mount stop lamp (CHMSL) work?
Yes
Is there battery voltage at BTCM pin B9 backprobed with the brake applied?
Yes
Replace BTCM.
No
No
• Check circuit 820E for an open circuit.
• If circuit ok, replace LHJB.
No
Do the left and right side brake lights work?
Yes
Replace LHJB.
No
Is stop lamp fuse open?
Yes
• Check for short to ground in circuits 142 and 17.
• If circuit ok, replace LHJB.
No
Disconnect brake switch, install jumper between pins A and B of connector. Do brake lights work now?
Yes
Replace brake switch.
No
Is there battery voltage at brake switch pin B?
No
Repair open in circuit 142.
Yes
• Check for open in circuit 17.
• If circuit ok, replace LHJB.

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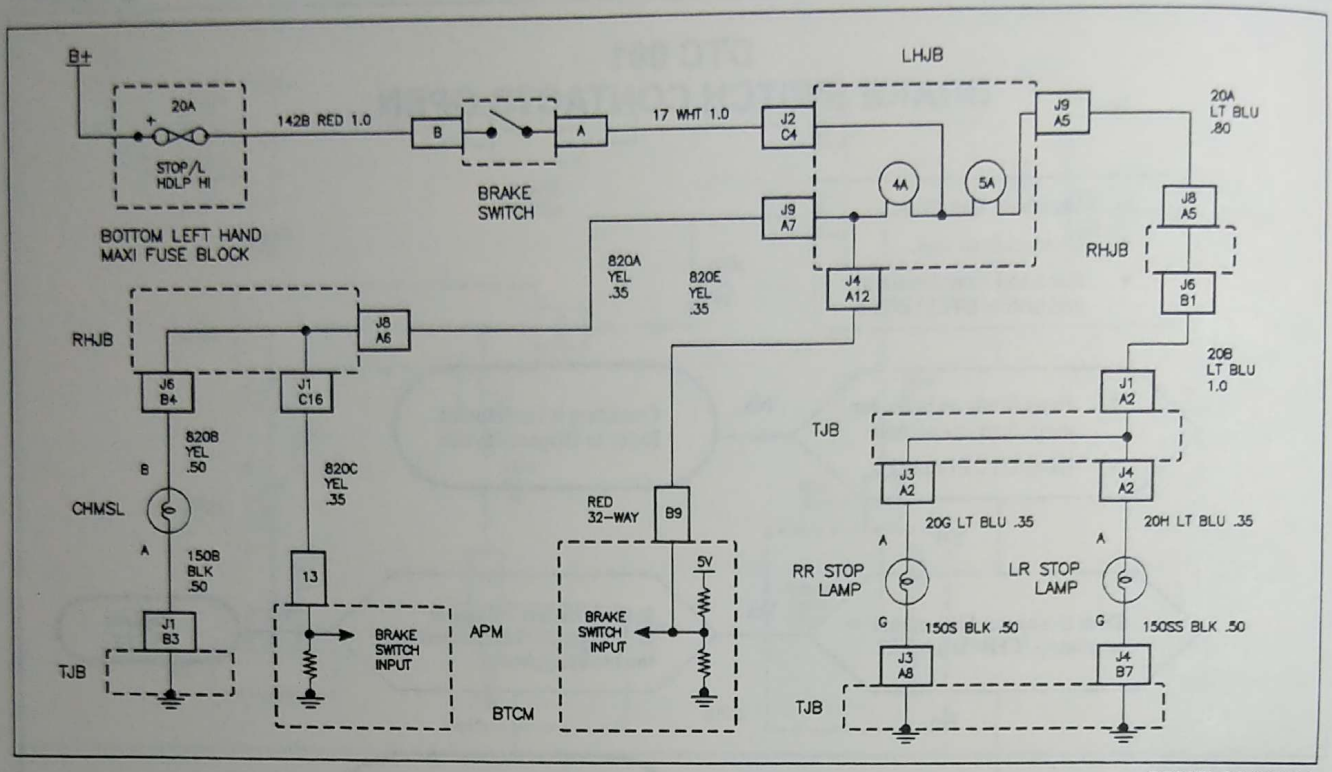
DTC 094 – BRAKE SWITCH CONTACTS ALWAYS CLOSED



PSMELC67495AA

BRAKE SWITCH CONTACTS ALWAYS CLOSED

If the brake switch contacts fail to open over a period of time this fault will be set. The brake torque control module (BTCM) will still recognize a request to stop because the master cylinder pressure sensors will indicate the drivers input.

DTC PARAMETERS

DTC 094 will set if:

- Brake switch failed (contacts shorted or plunger stick).
- Brake switch circuit shorted to battery.

DTC 094 will set when:

This fault can be set anytime the BTCM is awake. The DTC will set if three acceleration cycles occur with the brake switch always On and the master cylinder pressures indicating a driver input of less than 33 kPa (4.8 psi). This DTC will also set if the vehicle speed is greater than 80 km/h (50 mph) and the brake switch is always On for five minutes.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally. Brake pedal feel will change, there may be a slight brake drag and the brake lights will remain On continuously even with vehicle in lock mode.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 094
BRAKE SWITCH CONTACTS ALWAYS CLOSED

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.

Are the brake lights stuck On?
- No → Condition may be intermittent. Refer to Diagnostic Aids.
- Yes ↓

Check brake switch orientation per brake switch R&R – is brake switch properly oriented?
- No → Re-orientate brake switch per brake switch R&R.
- Yes ↓

Disconnect brake switch. Are the brake lights Off now?
- Yes → Replace the brake switch.
- No ↓

Disconnect RHJB J6 connector. Are the left and right side stop lamps still On?
- Yes →
  - Check for short to voltage on circuits 20B, 20G or 20H.
  - If circuits ok, replace TJB.
- No ↓

Is the center high-mount stop lamp (CHMSL) still On?
- Yes → Repair short to voltage on circuit 820B.
- No ↓

- Reconnect RHJB J6 connector.
- Disconnect LHJB J9 connector.
- Are the left and right side stop lamps On?

- Yes →
  - Check for short to voltage on circuit 20A.
  - If circuit ok, replace RHJB.
- No ↓

Is the CHMSL On?
- Yes →
  - Check for short to voltage on circuit 820A and 820C.
  - If circuit ok, replace RHJB.
- No ↓

- Check for short to voltage on circuits 17 and 820E.
- If circuits ok, replace LHJB.

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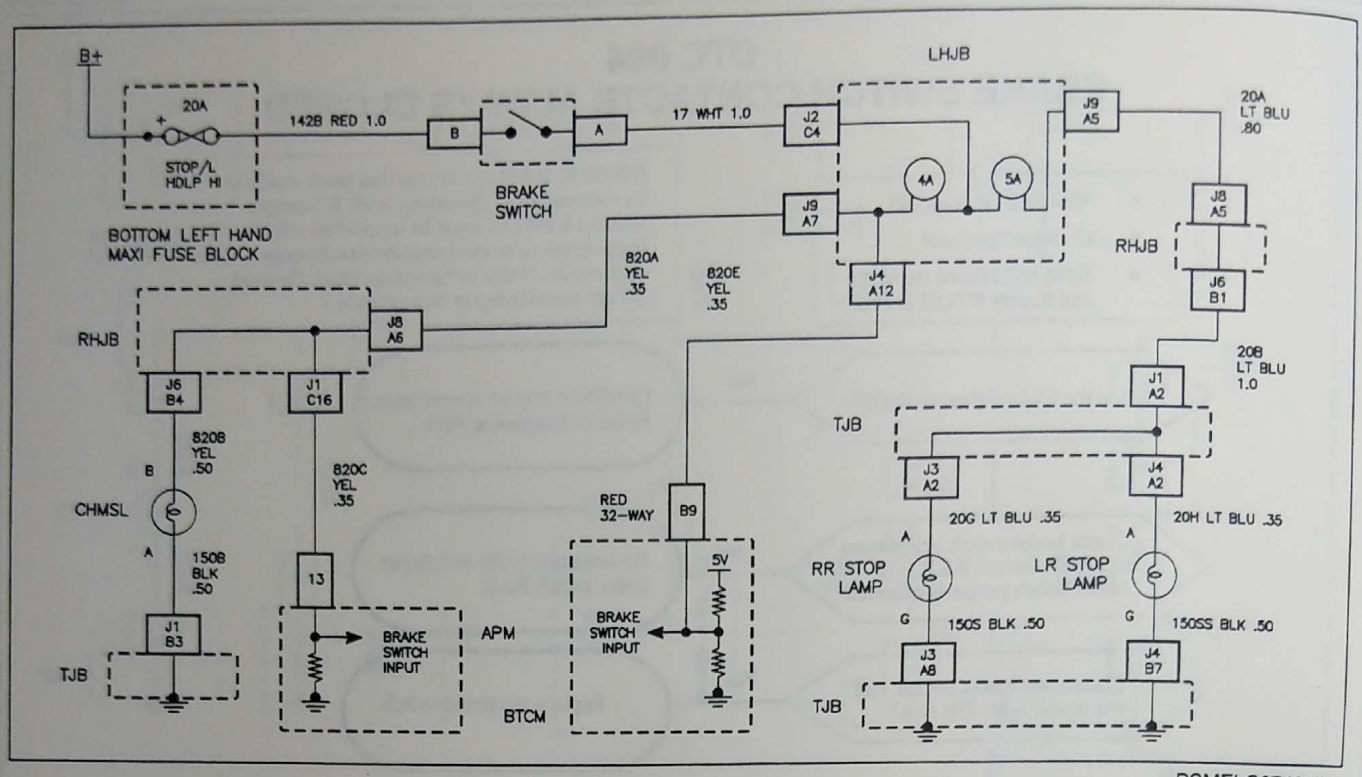
DTC 095 – BRAKE SWITCH CIRCUIT OPEN



PSMELC67495AA

BRAKE SWITCH CIRCUIT OPEN

The brake torque control module (BTCM) monitors voltage on the brake switch circuit. If an open circuit is detected this fault will set.

DTC PARAMETERS

DTC 095 will set if:

- Brake switch circuit open or high resistance.
- Brake switch failed (contacts open or plunger stuck).
- Brake lamps ground circuit open or high resistance.

DTC 095 will set when:

This fault can be set anytime the BTCM is awake. The DTC will set if the brake input voltage is detected between 2.0 volts and 8.6 volts.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally. Brake pedal feel will change and the brake lights will not operate.

RELATED DTCS

BTCM 96

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 095
BRAKE SWITCH CIRCUIT OPEN

NOTICE: If RH or LH junction block needs to be removed from mounting studs for diagnosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.

Is DTC 96 set?

Yes → Diagnose DTC 96 first.

No

Clear BTCM DTCs, then cycle vehicle Off and back On.

Does DTC 95 reset?

No → Problem is intermittent. Refer to Diagnostic aids.

Yes

During the following procedure do not apply the brake pedal or inaccurate readings may result.

Is there over 2.0 volts at BTCM 32 pin connector pin B9 backprobed?

No → Check terminal connection at BTCM. If connector ok, replace BTCM.

Yes

Is there over 2.0 volts at LHJB J4 pin A12 backprobed?

No → Repair open in circuit 820E.

Yes

- Check trunk junction block (TJB) for poor/loose ground.
- If TJB ground ok, replace LHJB.

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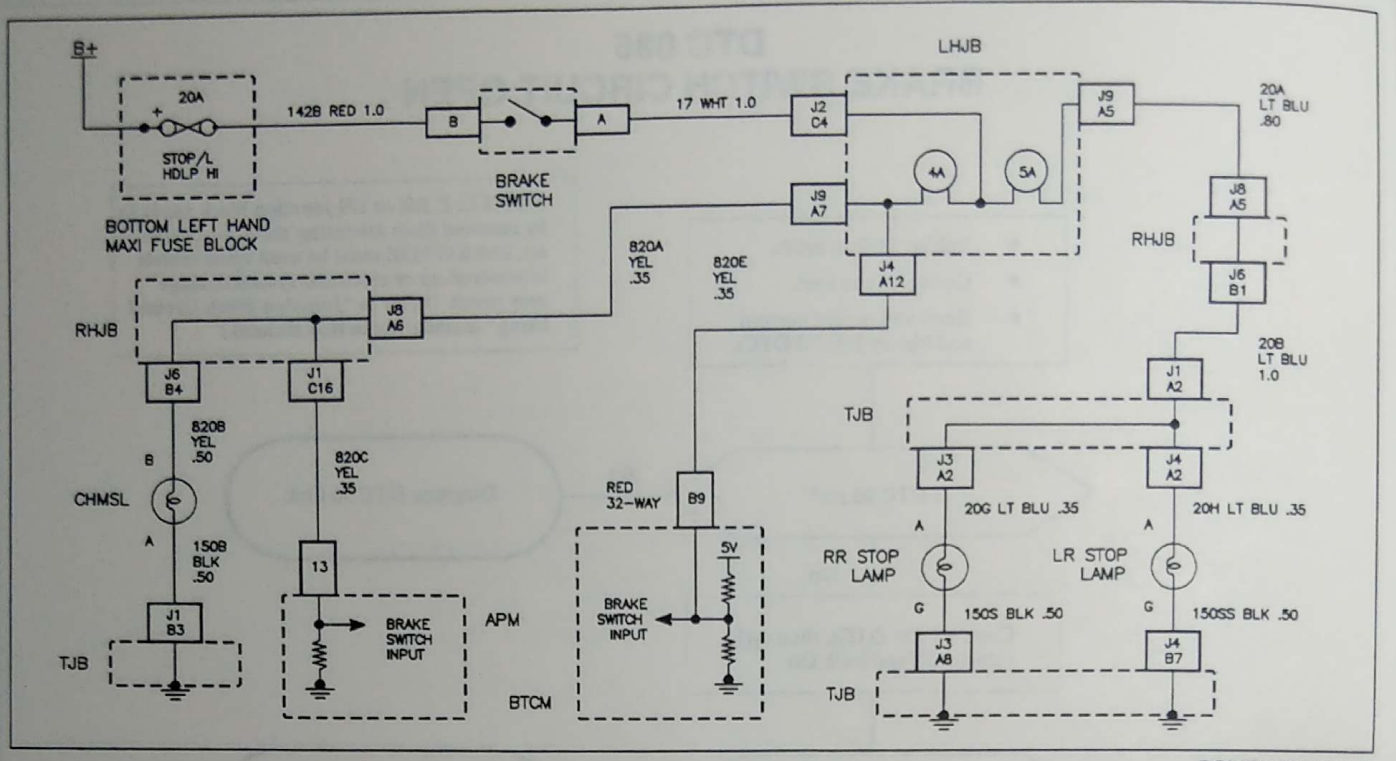
DTC 096 – BRAKE LIGHTS SUPPLY OR GROUND CIRCUIT OPEN



PSMELC67495AA

BRAKE LIGHTS SUPPLY OR GROUND CIRCUIT OPEN

The brake torque control module (BTCM) monitors voltage on the brake switch circuit. If an open circuit is detected this fault will set.

DTC PARAMETERS

DTC 096 will set if:

- Brake switch lamp circuit open or high resistance.
- Brake lamps ground circuit open or high resistance.

DTC 096 will set when:

This fault can be set anytime the BTCM is awake after a DTC 95 has been detected. The DTC will set when the brake switch is closed and will aid in determining why a DTC 95 was set.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally. Brake pedal feel will change and the brake lights may dim.

RELATED DTCS

BTCM 95

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 096
BRAKE LIGHTS SUPPLY OR GROUND CIRCUIT OPEN

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.
- Press and hold brake pedal for 10 seconds.

Did DTC 96 reset?

No → Problem is intermittent. Refer to Diagnostic aids.

Yes → Check trunk junction block (TJB) for poor/loose ground.

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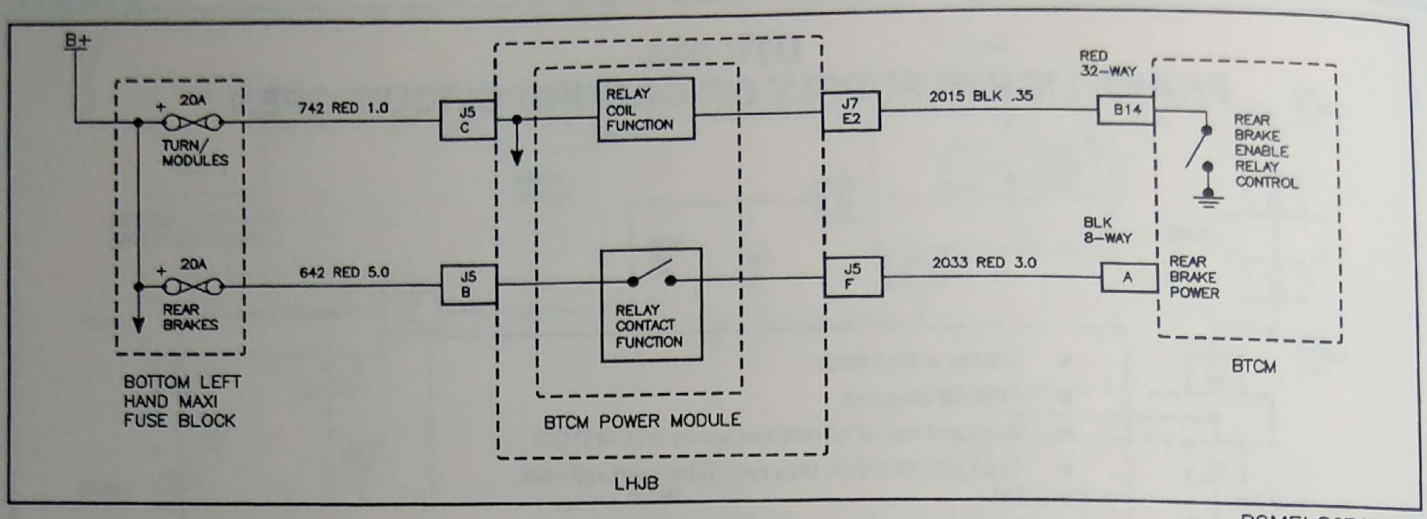
DTC 114 – REAR ENABLE RELAY CONTACT CIRCUIT OPEN



PSMELC67476AC

REAR ENABLE RELAY CONTACT CIRCUIT OPEN

The brake torque control module (BTCM) receives switched battery voltage for the rear braking system when the solid state rear enable relay contact circuit is closed. This input provides voltage and current to power the rear motors. If the BTCM detects a fault in this circuit it will disable rear apply and ABS.

DTC PARAMETERS

DTC 114 will set if:

- The brakes rear fuse is open.
- The solid state rear enable relay contacts are open.
- The solid state rear enable relay contacts circuit is open.
- The rear switched battery circuit is open.

DTC 114 will set when:

Run 1 is present, the BTCM commands the rear enable relay On, the quad driver module (QDM) output for the front relay coil is less than 3.0 volts and the front switched voltage is less than 7.0 volts.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS. The front brakes and regen will function normally.

RELATED DTCS

BTCM 116

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE telltale flashes when parking brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 114
REAR ENABLE RELAY CONTACT CIRCUIT OPEN

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic aids.

Yes

Cycle vehicle Off and back On without clearing DTCs. Is BTCM DTC 116 present now?

Yes → Perform DTC 116 diagnostic procedure.

No

Check the 20 amp brakes rear maxifuse located in the bottom maxifuse block. Is fuse ok?

No →
- Check for shorts to ground.
- Replace brakes rear fuse.

Yes

NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.

- Vehicle in Run mode.
- Jumper circuit 2015 to ground at BTCM pin B14.
- Measure voltage on circuit 2033 at the BTCM 8 way connector pin A.
- Is battery voltage present?

Yes → Terminal tightness or BTCM.

No

Is resistance on circuit 2033 between BTCM and LHJB less than 2.0 ohms?

No → Repair open in circuit 2033.

Yes

Terminal tightness or LHJB.

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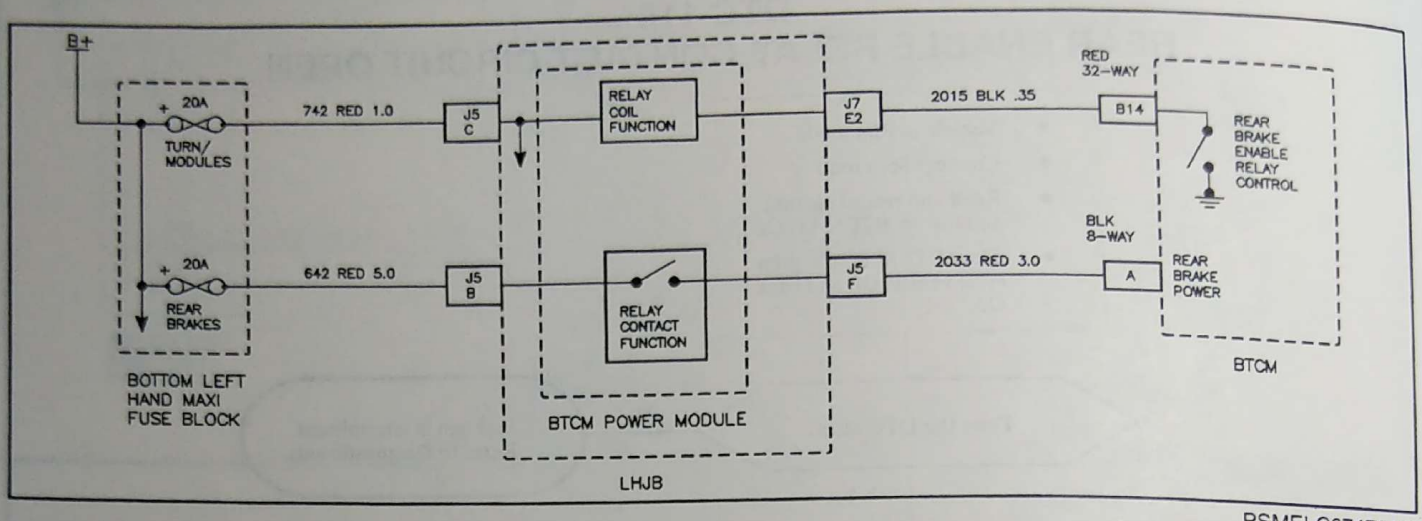
DTC 115 – REAR ENABLE RELAY CONTACT CIRCUIT SHORTED TO BATTERY VOLTAGE



PSMELC67476AC

REAR ENABLE RELAY CONTACT CIRCUIT SHORTED TO BATTERY VOLTAGE

The brake torque control module (BTCM) receives switched battery voltage for the rear braking system when the solid state rear enable relay contact circuit is closed. This input provides voltage and current to power the rear motors. If the BTCM detects a fault in this circuit it will turn On the BRAKE telltale.

DTC PARAMETERS

DTC 115 will set if:

- The solid state rear enable relay contacts are always closed.
- Rear motor circuit shorted to battery.
- Short to battery is present on circuit 2033.

DTC 115 will set when:

Only during initialization before the BTCM commands the rear enable relay On (the relay is first commanded On during the five second bulb check). The DTC will set if the rear switched voltage is greater than 7.0 volts and the quad driver module (QDM) output for the rear enable relay coil is greater than 5.0 volts. The BTCM does not expect to detect voltage since the rear enable relay has not been commanded On.

IMPORTANT: DTC 115 can be set falsely if the vehicle is powered up less than 30 seconds after the negative auxiliary battery cable 60 amp maxi fuse has been reinstalled.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

BTCM 117 may show up in history.

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

- If the vehicle is powered up within 30 seconds after battery voltage has been restored to the BTCM, this code may set falsely.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

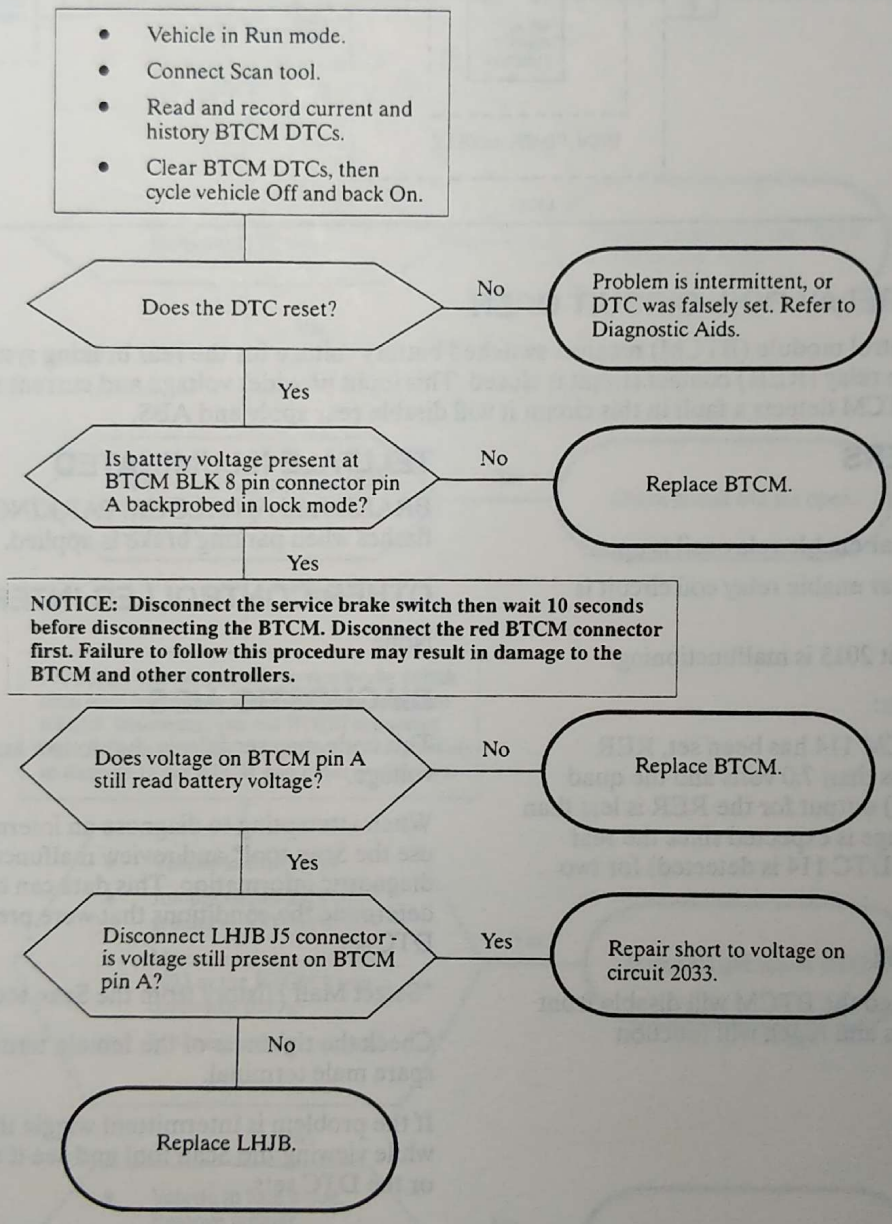
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

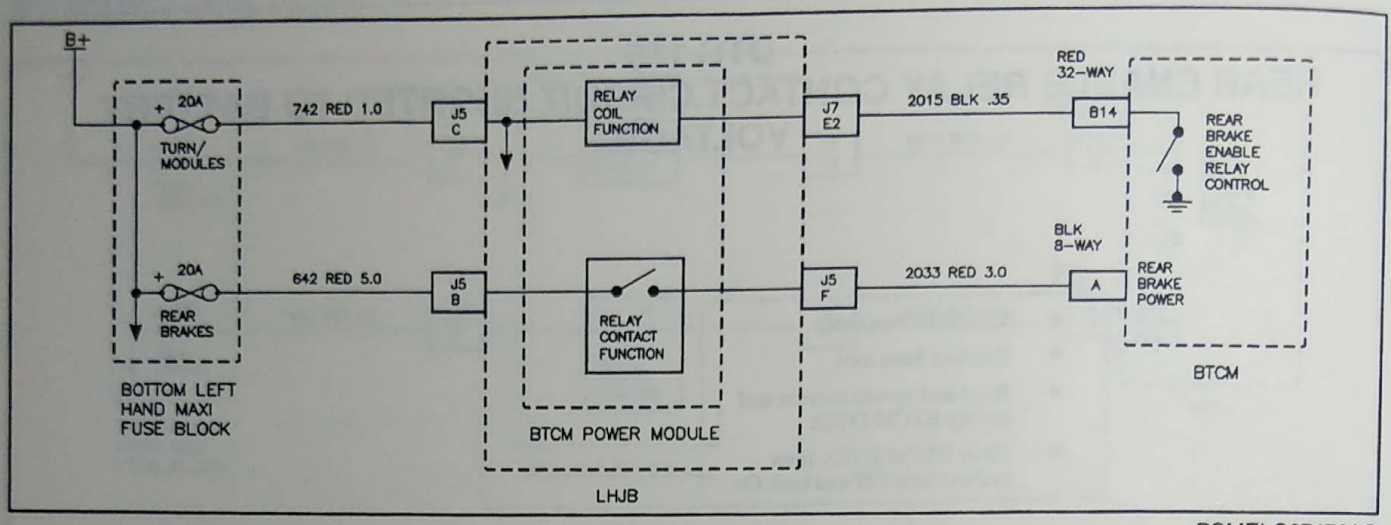
CamScanner

DTC 115
REAR ENABLE RELAY CONTACT CIRCUIT SHORTED TO BATTERY VOLTAGE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent, or DTC was falsely set. Refer to Diagnostic Aids.
Yes
Is battery voltage present at BTCM BLK 8 pin connector pin A backprobed in lock mode?
No
Replace BTCM.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Does voltage on BTCM pin A still read battery voltage?
No
Replace BTCM.
Yes
Disconnect LHJB J5 connector - is voltage still present on BTCM pin A?
Yes
Repair short to voltage on circuit 2033.
No
Replace LHJB.

CamScanner

DTC 116 – REAR ENABLE RELAY COIL CIRCUIT OPEN



PSMELC67476AC

REAR ENABLE RELAY COIL CIRCUIT OPEN

The brake torque control module (BTCM) receives switched battery voltage for the rear braking system when the solid state rear enable relay (RER) contact circuit is closed. This input provides voltage and current to power the rear motors. If the BTCM detects a fault in this circuit it will disable rear apply and ABS.

DTC PARAMETERS

DTC 116 will set if:

- The solid state rear enable relay coil is open.
- The solid state rear enable relay coil circuit is open.
- The BTCM circuit 2015 is malfunctioning.

DTC 116 will set when:

Run 1 is present, BTCM 114 has been set, RER switched voltage is less than 7.0 volts and the quad driver module (QDM) output for the RER is less than 5.0 volts (battery voltage is expected since the rear relay is disabled once DTC 114 is detected) for two seconds.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS. The front brakes and regen will function normally.

RELATED DTCS

BTCM 114

TELLTALE ILLUMINATED

BRAKE And ANTILOCK. PARKING BRAKE telltale flashes when parking brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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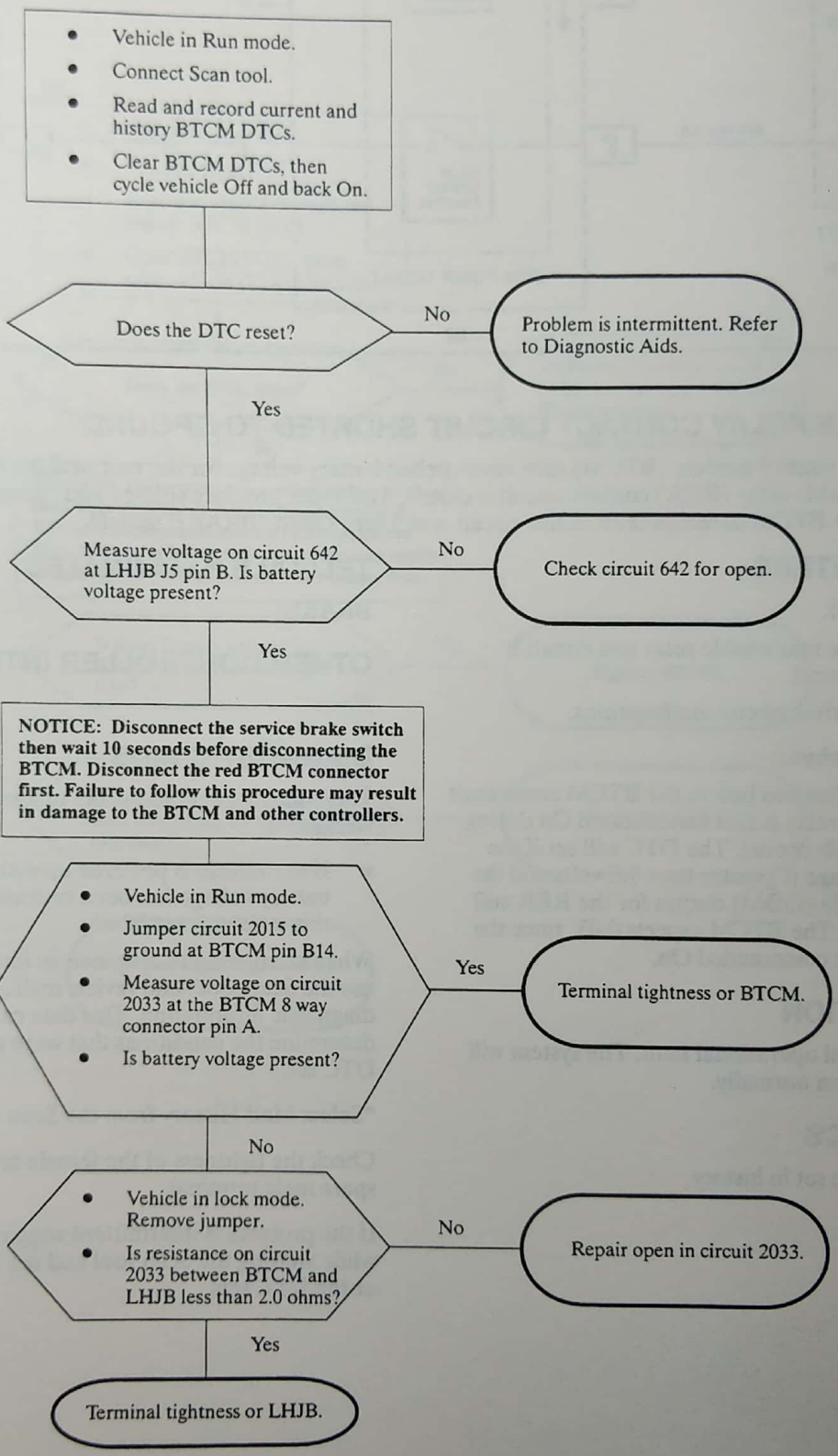
DTC 116
REAR ENABLE RELAY COIL CIRCUIT OPEN


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Measure voltage on circuit 642 at LHJB J5 pin B. Is battery voltage present?
No
Check circuit 642 for open.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Vehicle in Run mode.
Jumper circuit 2015 to ground at BTCM pin B14.
Measure voltage on circuit 2033 at the BTCM 8 way connector pin A.
Is battery voltage present?
Yes
Terminal tightness or BTCM.
No
Vehicle in lock mode. Remove jumper.
Is resistance on circuit 2033 between BTCM and LHJB less than 2.0 ohms?
No
Repair open in circuit 2033.
Yes
Terminal tightness or LHJB.

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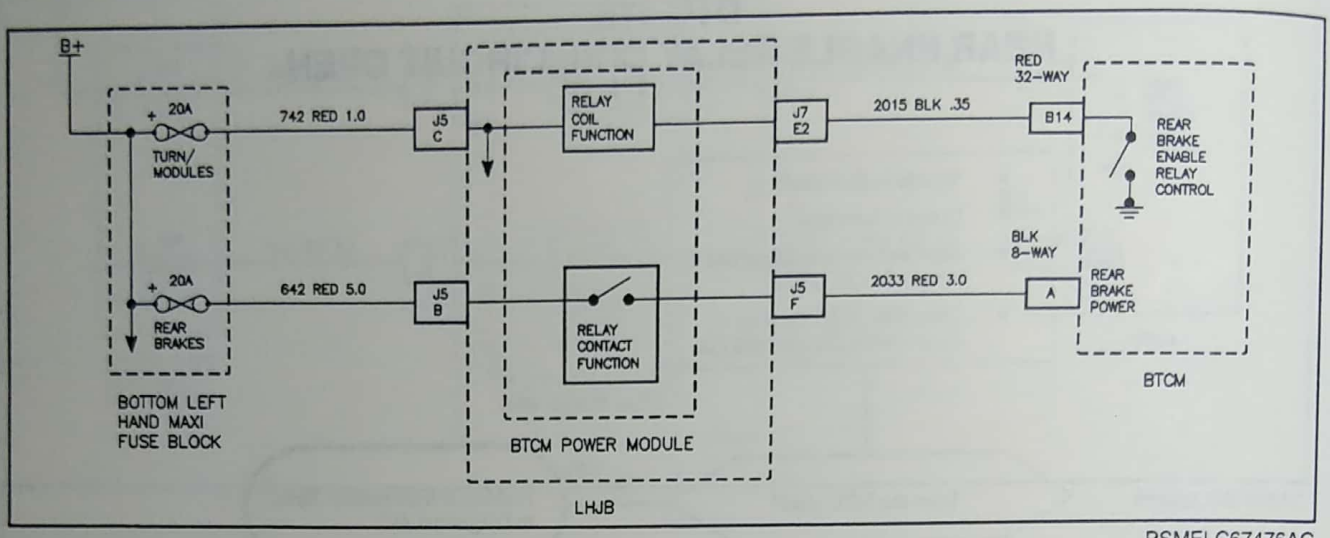
DTC 117 – REAR ENABLE RELAY CONTACT CIRCUIT SHORTED TO GROUND



PSMELC67476AC

REAR ENABLE RELAY CONTACT CIRCUIT SHORTED TO GROUND

The brake torque control module (BTCM) receives switched battery voltage for the rear braking system when the solid state rear enable relay (RER) contact circuit is closed. This input provides voltage and current to power the rear motors. If the BTCM detects a fault in this circuit it will turn On the BRAKE telltale.

DTC PARAMETERS

DTC 117 will set if:

- The solid state rear enable relay coil circuit is shorted to ground.
- The BTCM driver circuit malfunctions.

DTC 117 will set when:

Only during initialization before the BTCM commands the RER On (the relay is first commanded On during the five second bulb check). The DTC will set if the rear switched voltage is greater than 7.0 volts and the quad driver module (QDM) output for the RER coil less than 5.0 volts. The BTCM expects 0.0V since the RER has not been commanded On.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

BTCM 115 may be set in history.

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

- If the vehicle is powered up within 30 seconds after battery voltage has been restored to the BTCM, this code may set falsely.

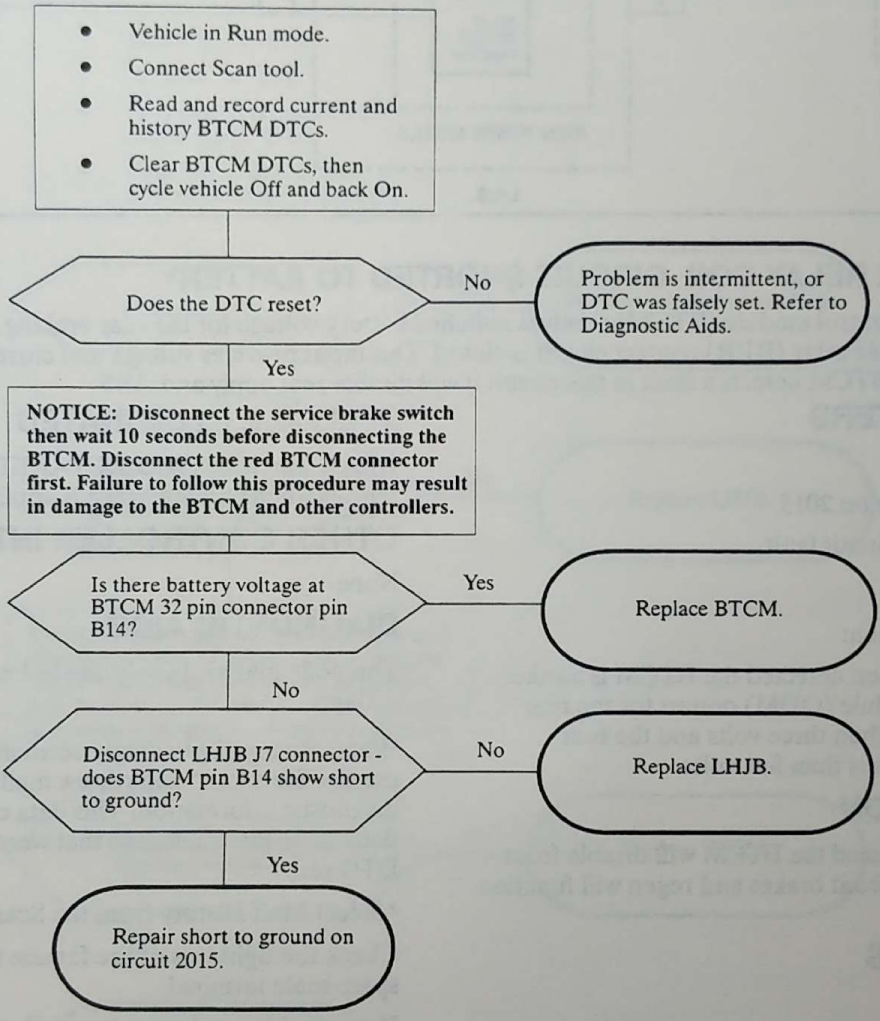
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

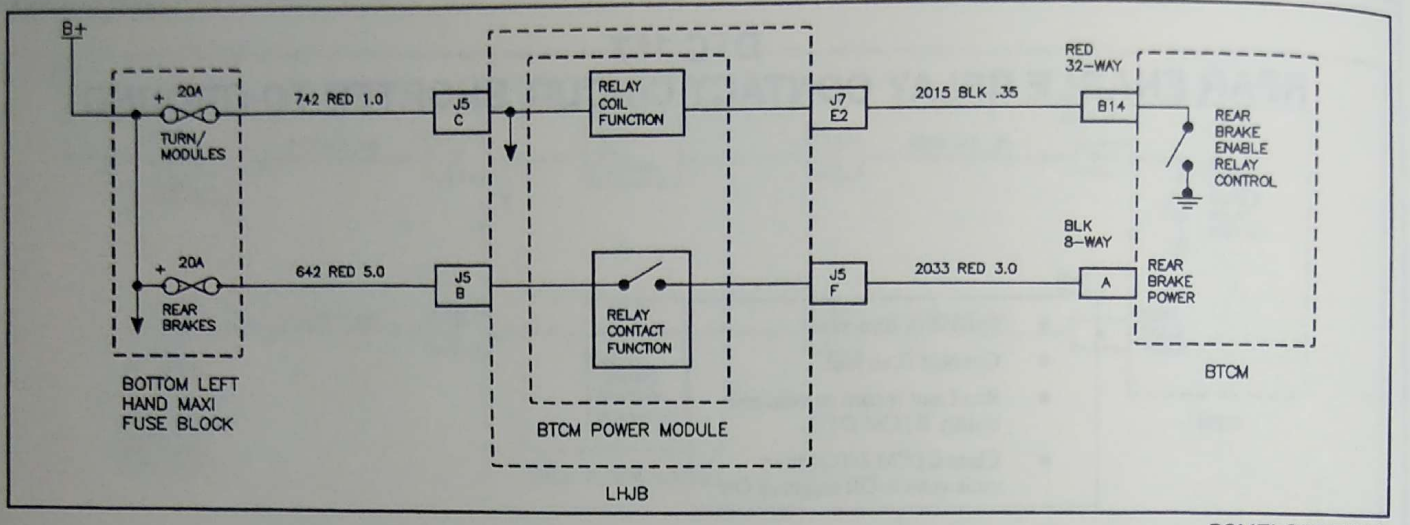
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 117
REAR ENABLE RELAY CONTACT CIRCUIT SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent, or DTC was falsely set. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is there battery voltage at BTCM 32 pin connector pin B14?
Yes
Replace BTCM.
No
Disconnect LHJB J7 connector - does BTCM pin B14 show short to ground?
No
Replace LHJB.
Yes
Repair short to ground on circuit 2015.

DTC 118 – REAR ENABLE RELAY COIL CIRCUIT SHORTED TO BATTERY



PSMELC67476AC

REAR ENABLE RELAY COIL CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) receives switched battery voltage for the rear braking system when the solid state rear enable relay (RER) contact circuit is closed. This input provides voltage and current to power the rear motors. If the BTCM detects a fault in this circuit it will disable rear apply and ABS.

DTC PARAMETERS

DTC 118 will set if:

- Short to voltage on 2015.
- BTCM driver circuit fault.
- LHJB fault.

DTC 118 will set when:

DTC 114 has not been detected the BTCM is awake, the quad driver module (QDM) output for the rear relay coil is greater than three volts and the rear switched voltage is less than five volts.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS. The front brakes and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE telltale flashes when parking brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

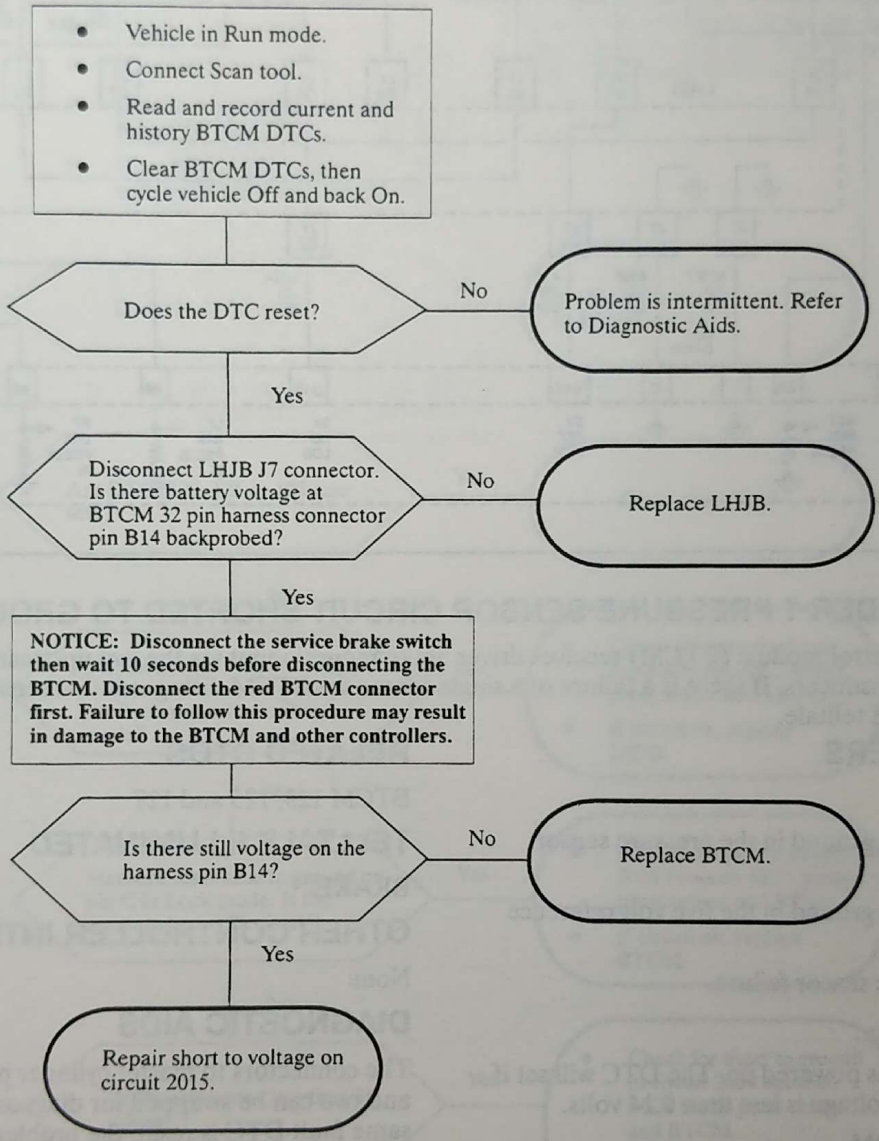
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 118
REAR ENABLE RELAY COIL CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect LHJB J7 connector. Is there battery voltage at BTCM 32 pin harness connector pin B14 backprobed?
No
Replace LHJB.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is there still voltage on the harness pin B14?
No
Replace BTCM.
Yes
Repair short to voltage on circuit 2015.

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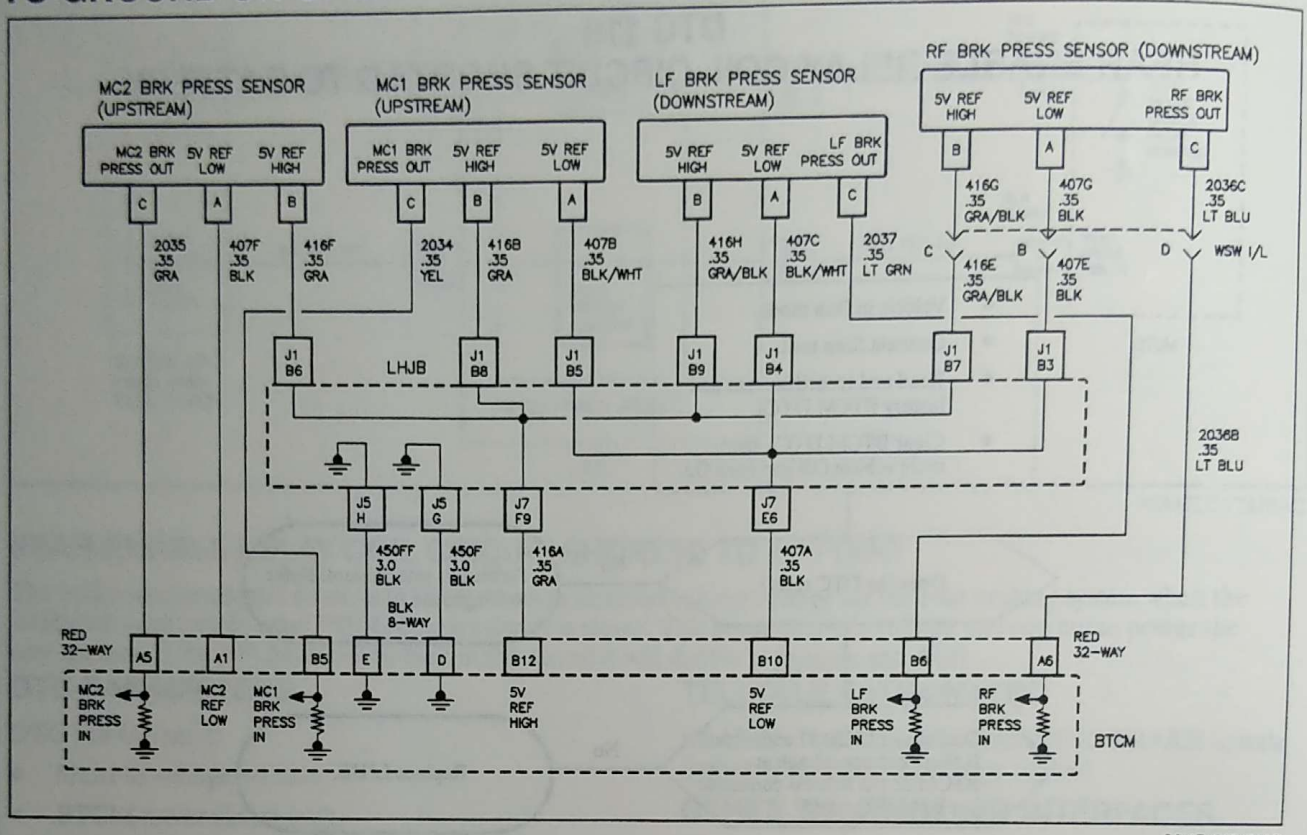
DTC 121 – MASTER CYLINDER 1 PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN



PSMELC67477AB

MASTER CYLINDER 1 PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN

The brake torque control module (BTCM) receives driver brake request input via the two upstream or master cylinder pressure transducers. If there is a failure of a single sensor the BTCM disregards that sensor's input and turns On the BRAKE telltale.

DTC PARAMETERS

DTC 121 will set if:

- Open or short to ground in the pressure sensor signal circuit.
- Open or short to ground in the five volt reference circuit.
- Internal pressure sensor failure.

DTC 121 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is less than 0.14 volts.

FAILURE ACTION

If only one of the master cylinder pressure sensors has failed this is not a critical operational fault. The brake fail telltale will be turned On and the system will continue to function normally.

If master cylinder pressure one has failed, and then if either master cylinder pressure two (DTC 123 or 124) or the brake switch (DTC 91, 94, or 95) fails, the BTCM will cause the front brakes to revert to manual operation, disable front ABS, disable rear brake apply and turn On the brake fail and the ABS telltales. The parking brake system and rear ABS will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 123, 125 and 127

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

The connectors to master cylinder pressure sensors one and two can be swapped for diagnostic purposes. If the same fault DTC is reset, the problem is in the wiring. If the fault changes to the other sensor DTC the problem is in the sensor.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 121
MASTER CYLINDER 1 PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN

NOTICE: If RH or LH junction block needs to be removed from mounting studs for dianosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.

Does the DTC reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

Are DTCs 123, 125 or 127 also set?

Yes → Go to chart 121B.

No

Disconnect MC1 brake pressure sensor - is there over 4.5 volts at pin B of connector in Run mode?

No →
- Check for open in circuit 416B between MC1 brake press sensor and LHJB.
- If circuit ok, replace LHJB.

Yes

Measure resistance to ground on pin C in Lock mode. Is the resistance over 8k ohms?

Yes →
- Check for open in circuit 2034 between MC1 brake press sensor and BTCM.
- If circuit ok, replace BTCM.

No

Is the resistance less than 3k ohms?

Yes →
- Check for short to ground in circuit 2034 between MC1 brake press sensor and BTCM.
- If circuit ok, replace BTCM.

No

Replace MC1 brake pressure sensor.

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DTC 121
MASTER CYLINDER 1 PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN

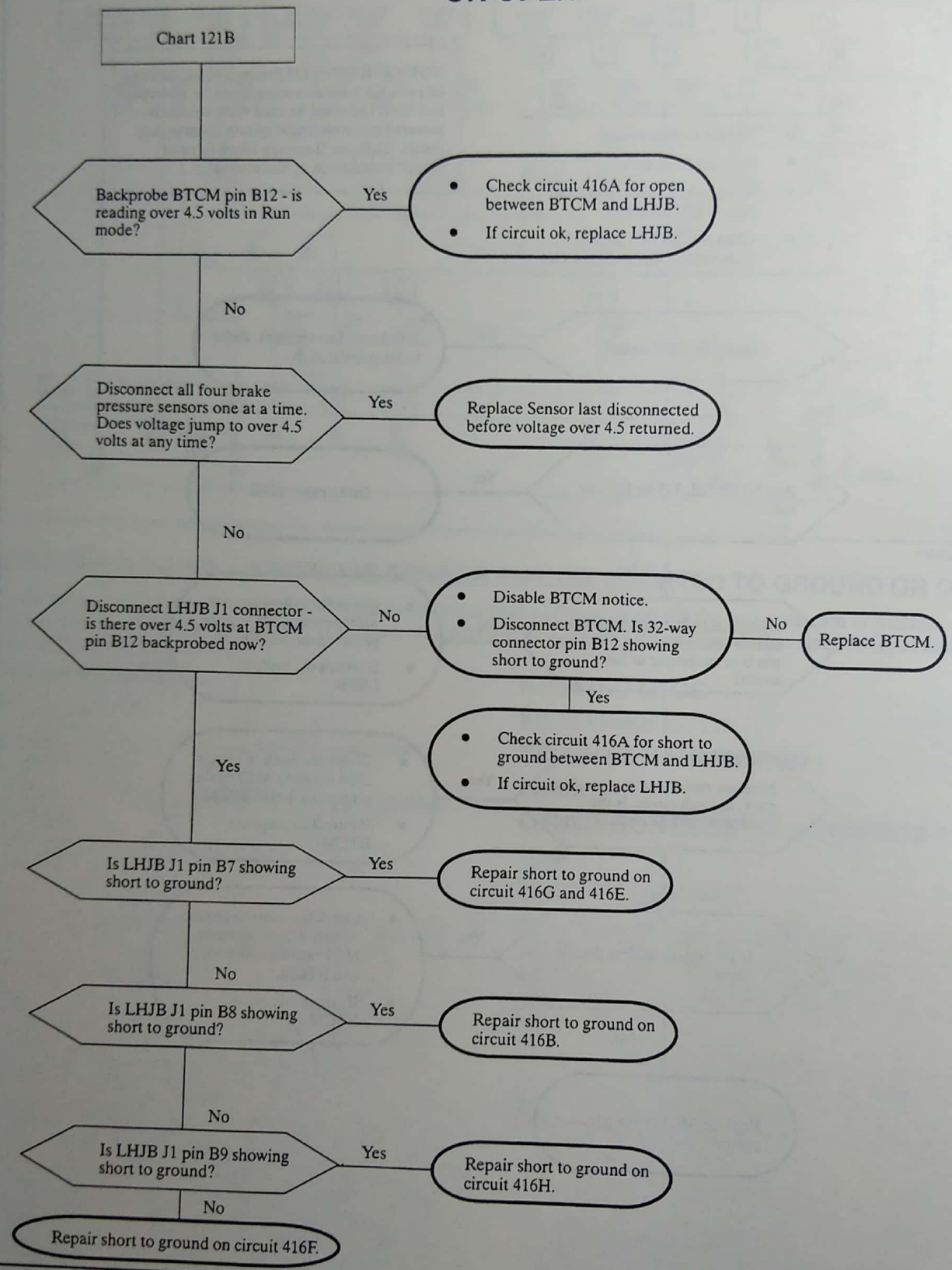
Chart 121B
Backprobe BTCM pin B12 - is reading over 4.5 volts in Run mode?
Yes
Check circuit 416A for open between BTCM and LHJB.
If circuit ok, replace LHJB.
No
Disconnect all four brake pressure sensors one at a time. Does voltage jump to over 4.5 volts at any time?
Yes
Replace Sensor last disconnected before voltage over 4.5 returned.
No
Disconnect LHJB J1 connector - is there over 4.5 volts at BTCM pin B12 backprobed now?
No
Disable BTCM notice.
Disconnect BTCM. Is 32-way connector pin B12 showing short to ground?
No
Replace BTCM.
Yes
Check circuit 416A for short to ground between BTCM and LHJB.
If circuit ok, replace LHJB.
Yes
Is LHJB J1 pin B7 showing short to ground?
Yes
Repair short to ground on circuit 416G and 416E.
No
Is LHJB J1 pin B8 showing short to ground?
Yes
Repair short to ground on circuit 416B.
No
Is LHJB J1 pin B9 showing short to ground?
Yes
Repair short to ground on circuit 416H.
No
Repair short to ground on circuit 416F.

NOTES

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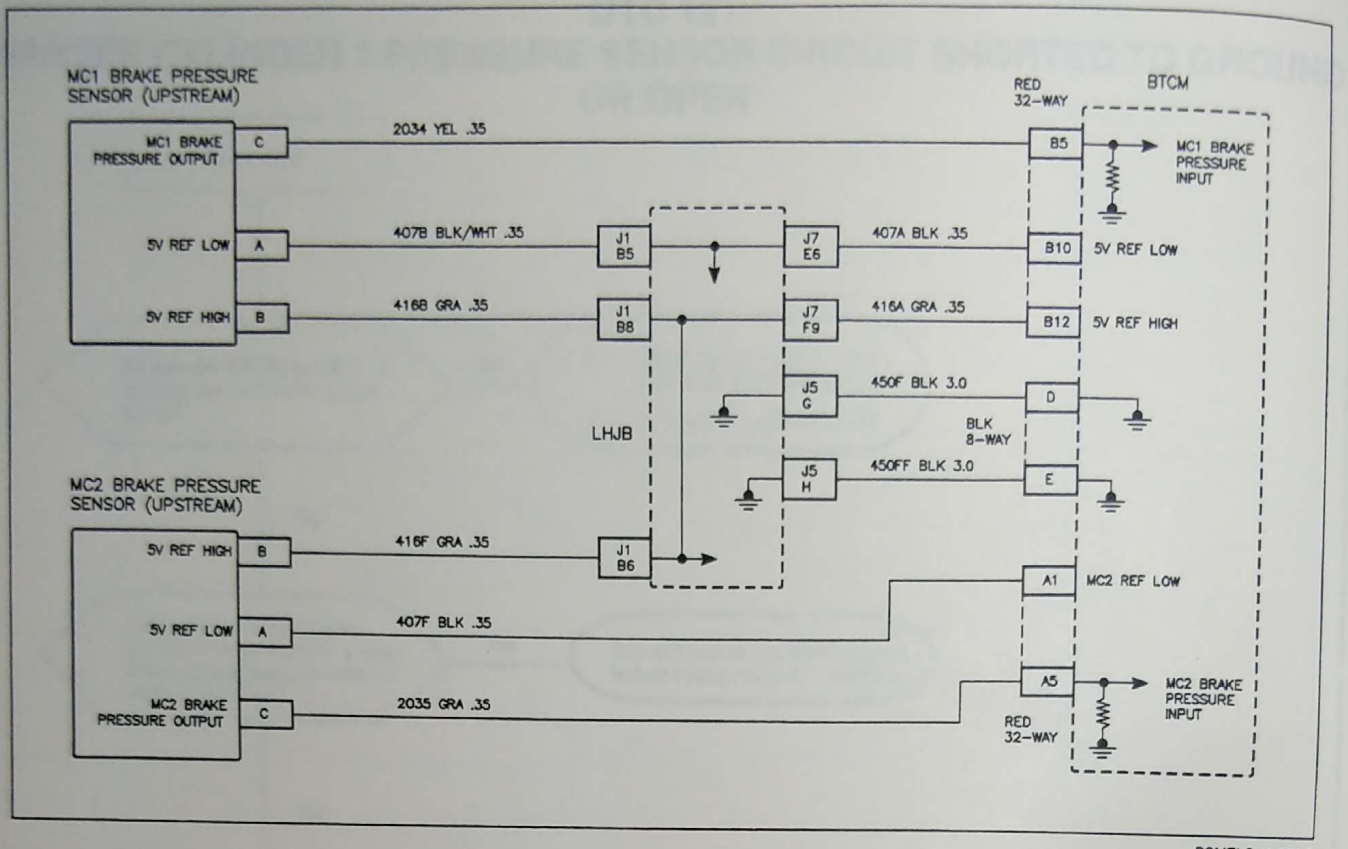
DTC 122 – MASTER CYLINDER 1 PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY



PSMELC67478AC

MASTER CYLINDER 1 PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) receives driver brake request input via the two upstream or master cylinder pressure transducers. If there is a failure of a single sensor the BTCM disregards that sensors input and turns On the BRAKE telltale.

DTC PARAMETERS

DTC 122 will set if:

- Short to battery voltage in the pressure sensor circuit.
- Internal pressure sensor failure.

DTC 122 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is more than 4.9 volts.

FAILURE ACTION

If only one of the master cylinder pressure sensors has failed this is not a critical operational fault. The brake fail telltale will be turned On and the system will continue to function normally.

If master cylinder pressure 1 has failed, and then if either master cylinder pressure 2 (DTC 123 or 124) or the brake switch (DTC 91, 94, or 95) fails, the BTCM will cause the front brakes to revert to manual operation, disable front ABS, disable rear brake apply and turn On the brake fail and the ABS telltales. The parking brake system and rear ABS will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

The connectors to master cylinder pressure sensors one and two can be swapped for diagnostic purposes. If the same fault DTC is reset, the problem is in the wiring. If the fault changes to the other sensor DTC the problem is in the sensor.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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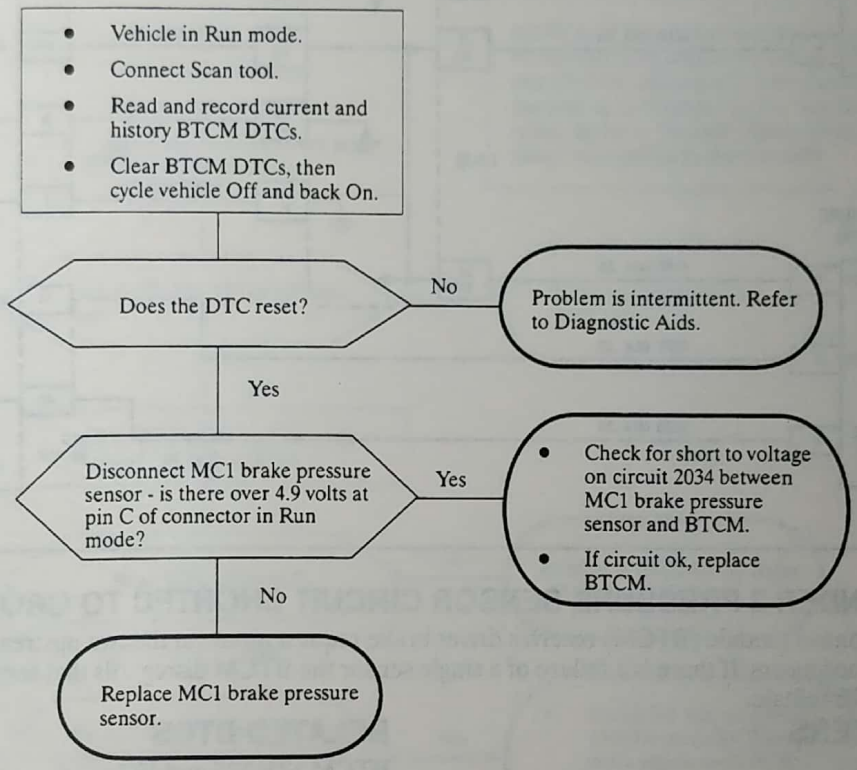
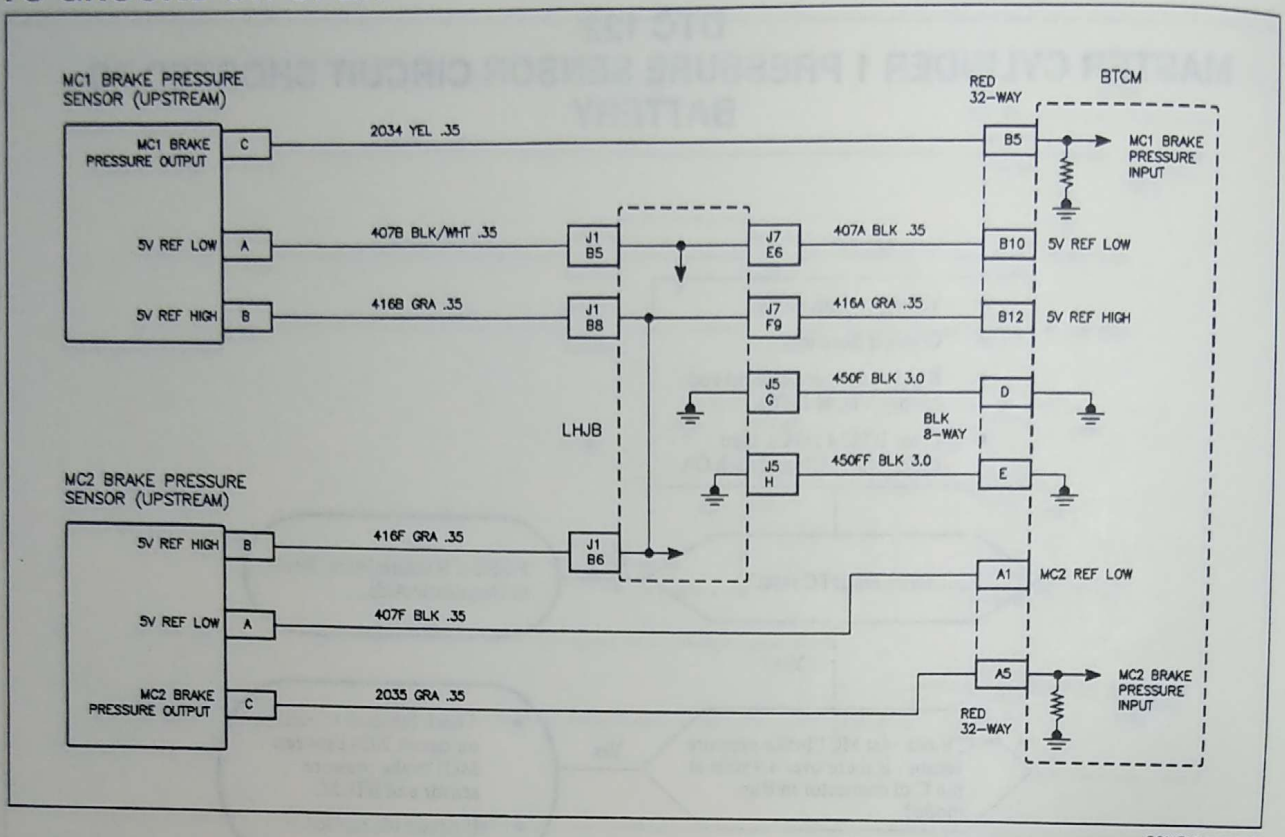
DTC 122
MASTER CYLINDER 1 PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect MC1 brake pressure sensor - is there over 4.9 volts at pin C of connector in Run mode?
Yes
Check for short to voltage on circuit 2034 between MC1 brake pressure sensor and BTCM.
If circuit ok, replace BTCM.
No
Replace MC1 brake pressure sensor.

DTC 123 – MASTER CYLINDER 2 PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN



PSMELC67478AC

MASTER CYLINDER 2 PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN

The brake torque control module (BTCM) receives driver brake request input via the two upstream or master cylinder pressure transducers. If there is a failure of a single sensor the BTCM disregards that sensor's input and turns On the BRAKE telltale.

DTC PARAMETERS

DTC 123 will set if:

- Open or short to ground in the pressure sensor signal circuit.
- Open or short to ground in the five volt reference circuit.
- Internal pressure sensor failure.

DTC 123 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is less than 0.14 volts.

FAILURE ACTION

If only one of the master cylinder pressure sensors has failed this is not a critical operational fault. The brake fail telltale will be turned On and the system will continue to function normally.

If master cylinder pressure 1 has failed, and then if either master cylinder pressure 2 (DTC 121 or 122) or the brake switch (DTC 91, 94, or 95) fails, the BTCM will cause the front brakes to revert to manual operation, disable front ABS, disable rear brake apply and turn On the brake fail and the ABS telltales. The parking brake system and rear ABS will function normally. Brake pedal travel will increase.

RELATED DTCS

BTCM 121, 125 and 127.

TELLTALE ILLUMINATED:

Brake System

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

The connectors to master cylinder pressure sensors one and two can be swapped for diagnostic purposes. If the same fault DTC is reset, the problem is in the wiring. If the fault changes to the other sensor DTC, the problem is in the sensor.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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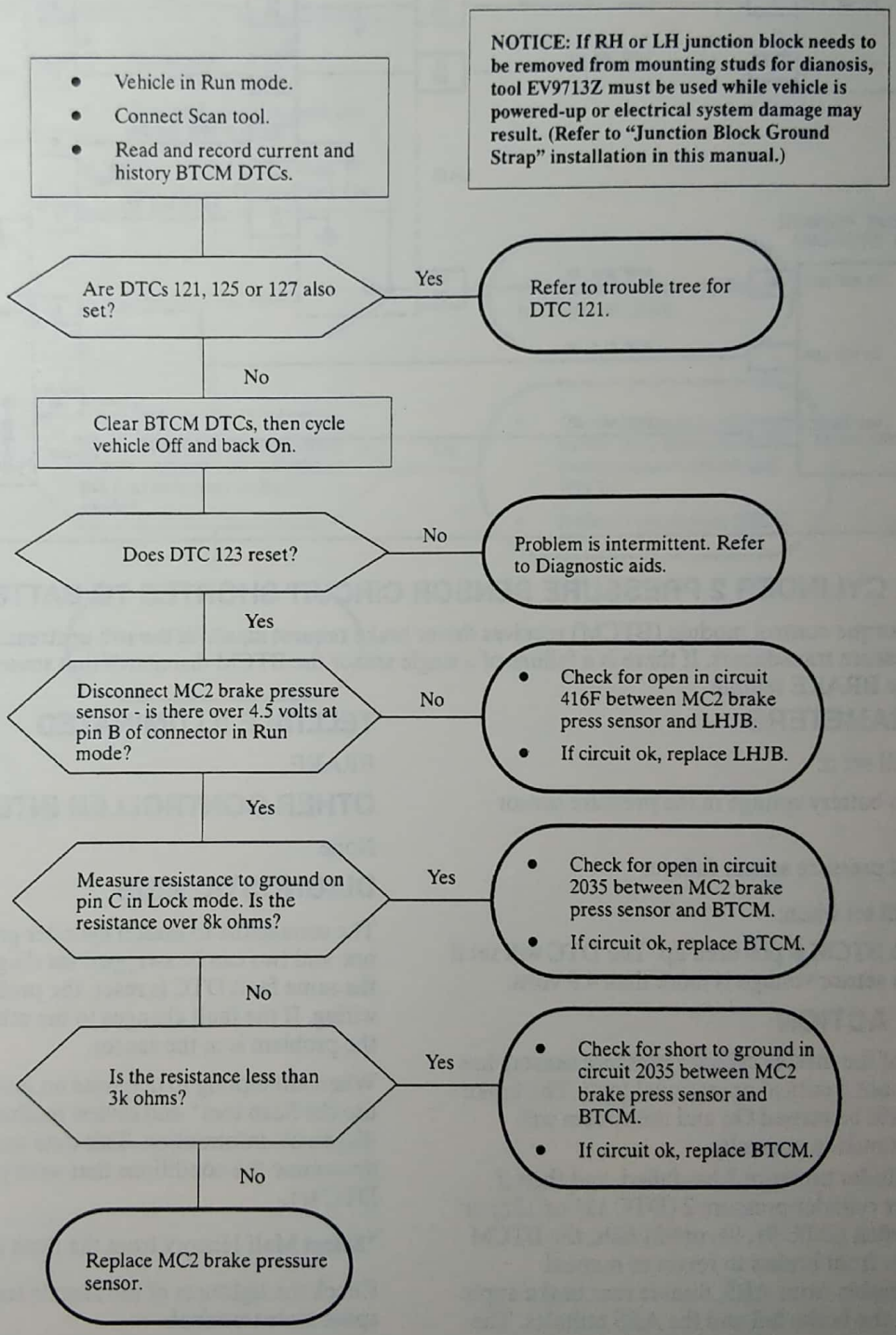
DTC 123
MASTER CYLINDER 2 PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN


NOTICE: If RH or LH junction block needs to be removed from mounting studs for dianosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)
Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are DTCs 121, 125 or 127 also set?
Yes
Refer to trouble tree for DTC 121.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does DTC 123 reset?
No
Problem is intermittent. Refer to Diagnostic aids.
Yes
Disconnect MC2 brake pressure sensor - is there over 4.5 volts at pin B of connector in Run mode?
No
Check for open in circuit 416F between MC2 brake press sensor and LHJB.
If circuit ok, replace LHJB.
Yes
Measure resistance to ground on pin C in Lock mode. Is the resistance over 8k ohms?
Yes
Check for open in circuit 2035 between MC2 brake press sensor and BTCM.
If circuit ok, replace BTCM.
No
Is the resistance less than 3k ohms?
Yes
Check for short to ground in circuit 2035 between MC2 brake press sensor and BTCM.
If circuit ok, replace BTCM.
No
Replace MC2 brake pressure sensor.

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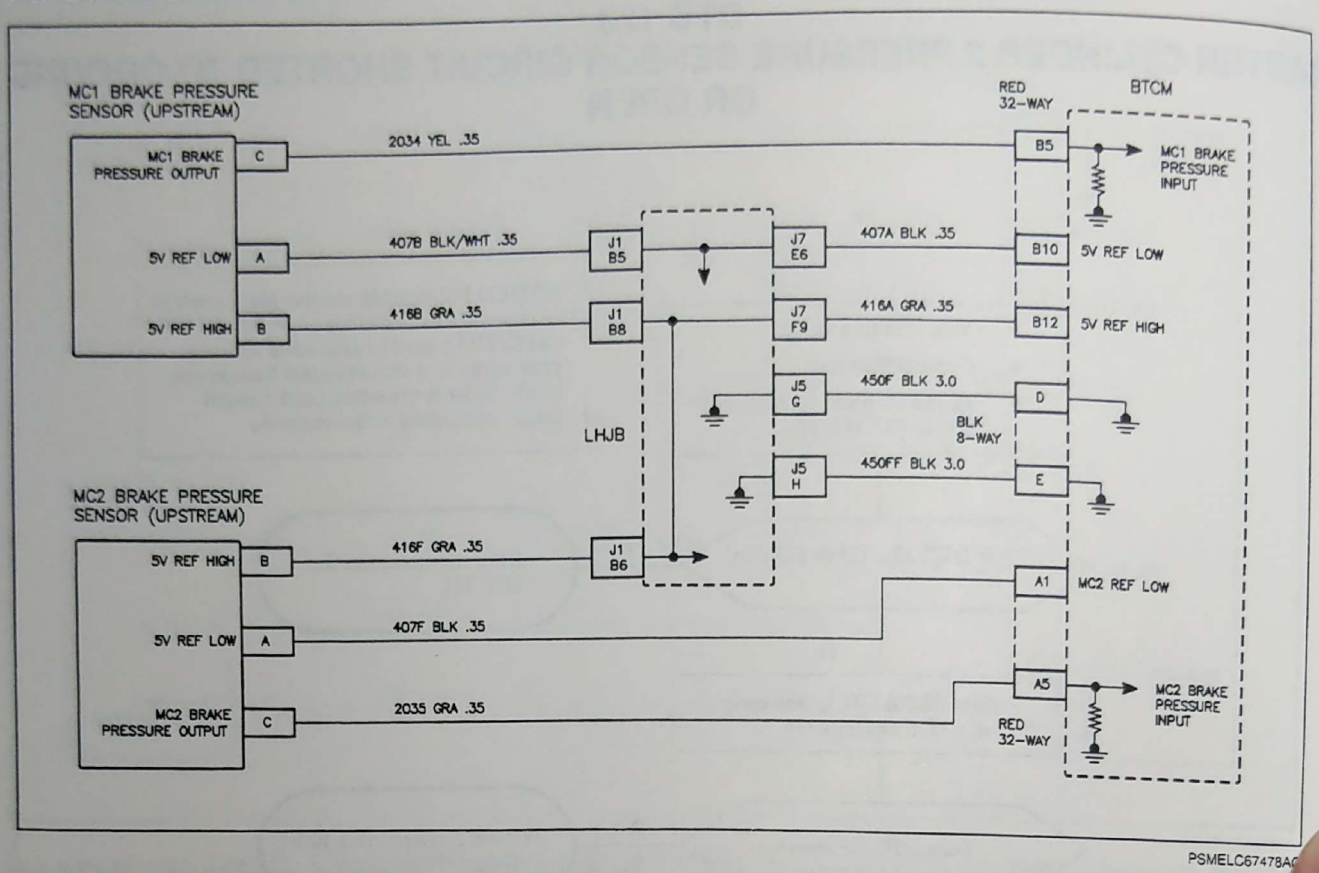
DTC 124 – MASTER CYLINDER 2 PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY



PSMELC67478AC

MASTER CYLINDER 2 PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) receives driver brake request input via the two upstream or master cylinder pressure transducers. If there is a failure of a single sensor the BTCM disregards that sensor's input and turns On the BRAKE telltale.

DTC PARAMETERS

DTC 124 will set if:

- Short to battery voltage in the pressure sensor circuit.
- Internal pressure sensor failure.

DTC 124 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is more than 4.9 volts.

FAILURE ACTION

If only one of the master cylinder pressure sensors has failed this is not a critical operational fault. The brake fail telltale will be turned On and the system will continue to function normally.

If master cylinder pressure 1 has failed, and then if either master cylinder pressure 2 (DTC 121 or 122) or the brake switch (DTC 91, 94, or 95) fails, the BTCM will cause the front brakes to revert to manual operation, disable front ABS, disable rear brake apply and turn On the brake fail and the ABS telltales. The parking brake system and rear ABS will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

The connectors to master cylinder pressure sensors one and two can be swapped for diagnostic purposes. If the same fault DTC is reset, the problem is in the wiring. If the fault changes to the other sensor DTC, the problem is in the sensor.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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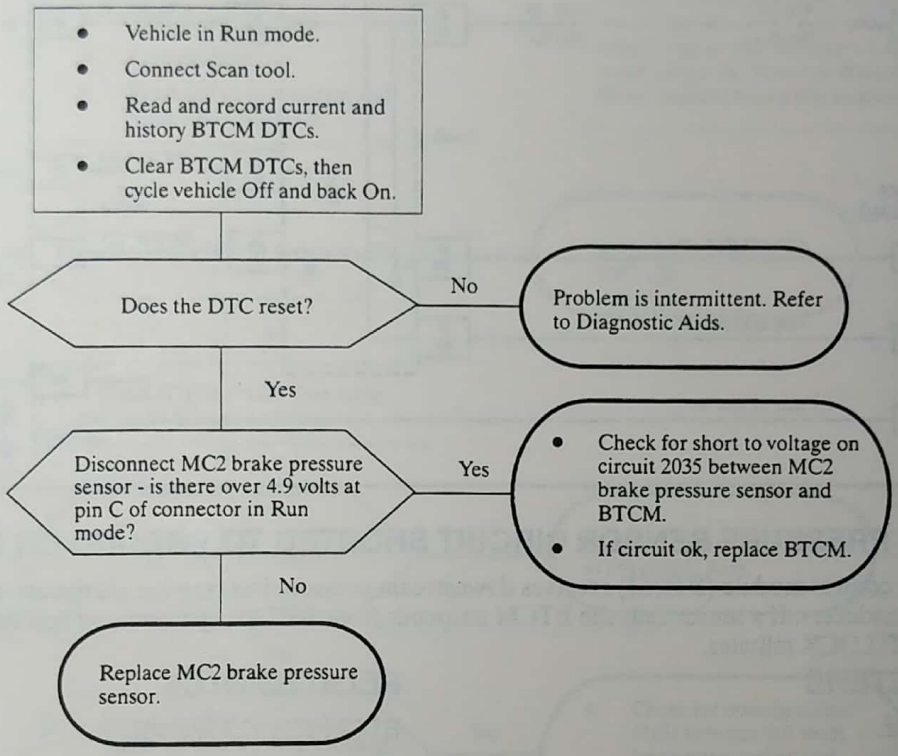
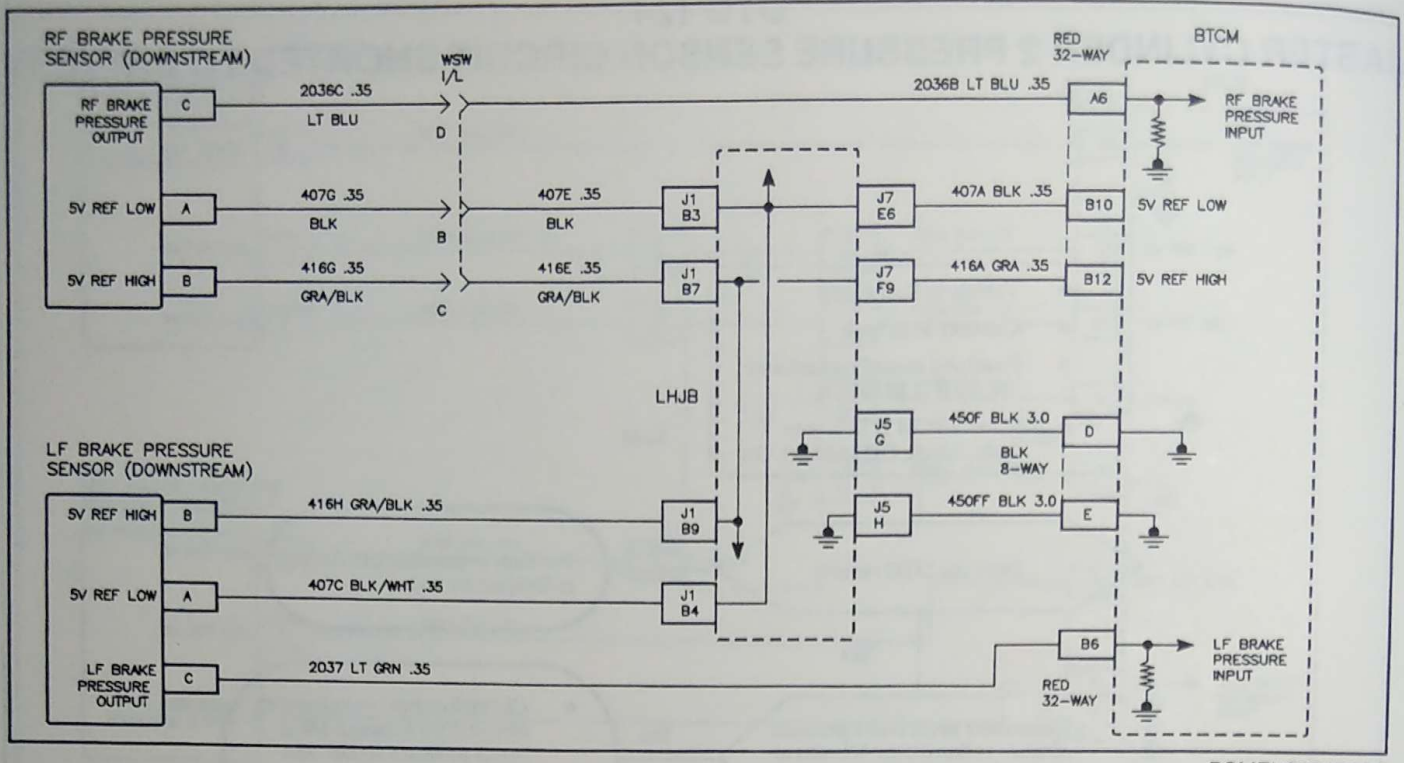
DTC 124
MASTER CYLINDER 2 PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect MC2 brake pressure sensor - is there over 4.9 volts at pin C of connector in Run mode?
Yes
Check for short to voltage on circuit 2035 between MC2 brake pressure sensor and BTCM.
If circuit ok, replace BTCM.
No
Replace MC2 brake pressure sensor.

CamScanner

DTC 125 – LEFT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN



PSMELC67479AC

LEFT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN

The brake torque control module (BTCM) receives downstream pressure information via the two downstream or front pressure transducers. If a sensor fails the BTCM suspends front ABS and power assist and turns On the BRAKE and ANTILOCK telltales.

DTC PARAMETERS

DTC 125 will set if:

- Open or short to ground in the pressure sensor signal circuit.
- Internal pressure sensor failure.
- Open or short to ground in five volt reference circuit.

DTC 125 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is less than 0.14 volts.

FAILURE ACTION

If this failure is detected, the BTCM will cause the front brakes to revert to manual operation, and disable front ABS. The rear brake system and regen will function normally

RELATED DTCS

BTCM 121, 123 and 127.

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 125
LEFT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN

NOTICE: If RH or LH junction block needs to be removed from mounting studs for dianosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.

Are DTCs 121, 123 or 127 also set?
- Yes → Refer to trouble tree for DTC 121.
- No → Clear BTCM DTCs, then cycle vehicle Off and back On.

Does DTC 125 reset?
- No → Problem is intermittent. Refer to Diagnostic Aids.
- Yes →

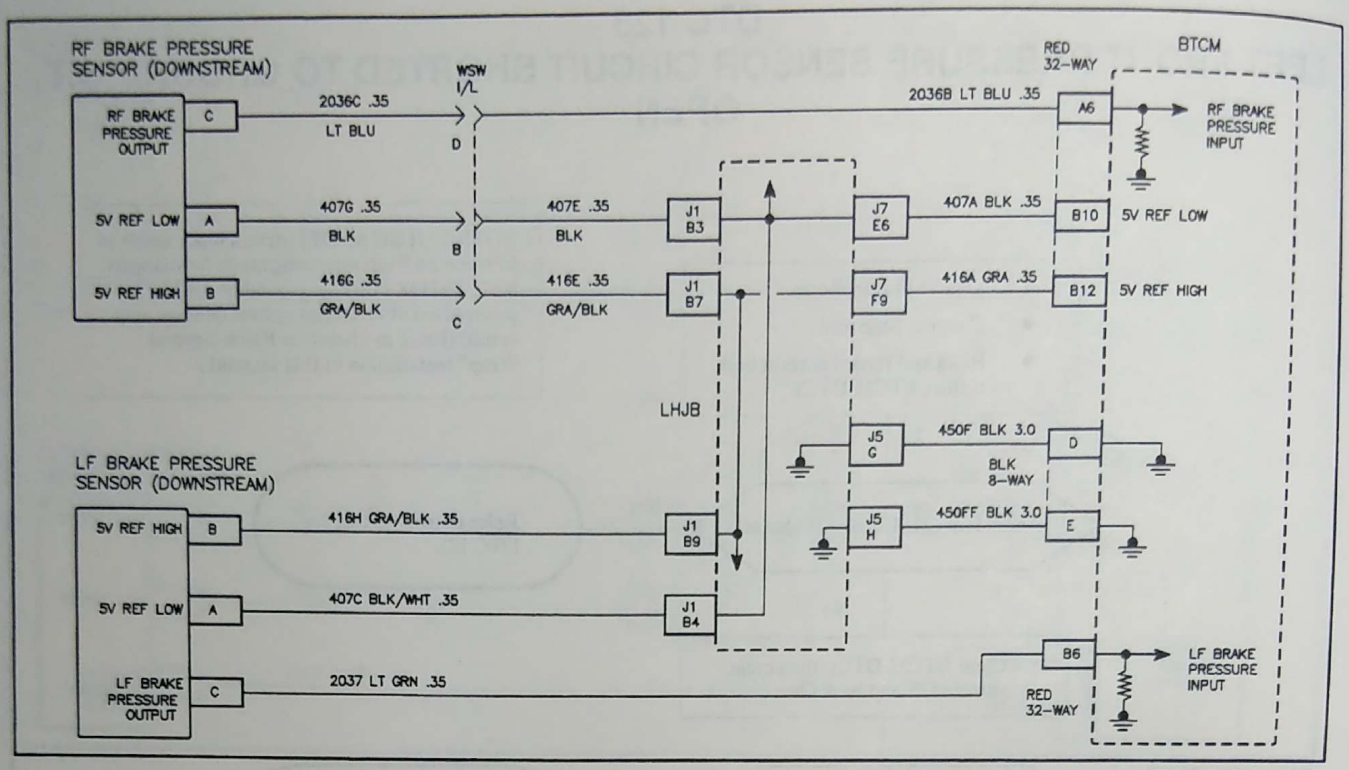
Disconnect left front brake sensor - is there over 4.5 volts at pin B of connector in Run mode?
- No →
  - Check for open in circuit 416H between left front brake press sensor and LHJB.
  - If circuit ok, replace LHJB.
- Yes →

Measure resistance to ground on pin C in Lock mode. Is the resistance over 8k ohms?
- Yes →
  - Check for open in circuit 2037 between left front brake press sensor and BTCM.
  - If circuit ok, replace BTCM.
- No →

Is the resistance less than 3k ohms?
- Yes →
  - Check for short to ground in circuit 2037 between left front brake press sensor and BTCM.
  - If circuit ok, replace BTCM.
- No → Replace left front brake pressure sensor.

CamScanner

DTC 126 – LEFT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY



PSMELC67479AB

LEFT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) receives downstream pressure information via the two downstream or front pressure transducers. If a sensor fails the BTCM suspends front ABS and power assist and turns On the BRAKE and ANTILOCK telltales.

DTC PARAMETERS

DTC 126 will set if:

- Short to battery voltage in the pressure sensor circuit.
- Internal pressure sensor failure.

DTC 126 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is more than 4.9 volts.

FAILURE ACTION

If this failure is detected, the BTCM will cause the front brakes to revert to manual operation, and disable front ABS. The rear brake system and regen will function normally

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

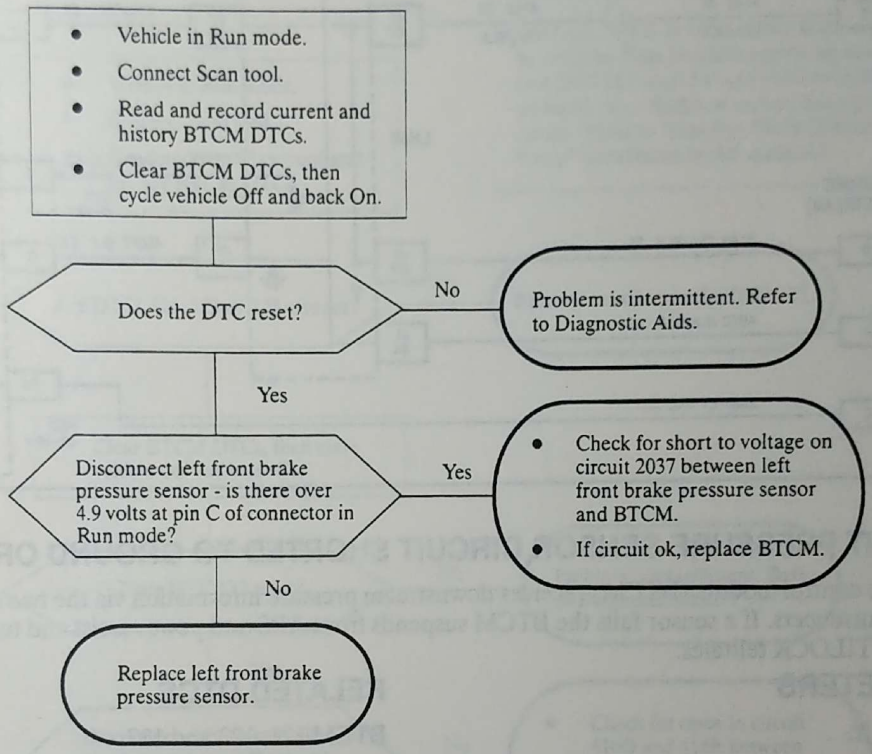
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

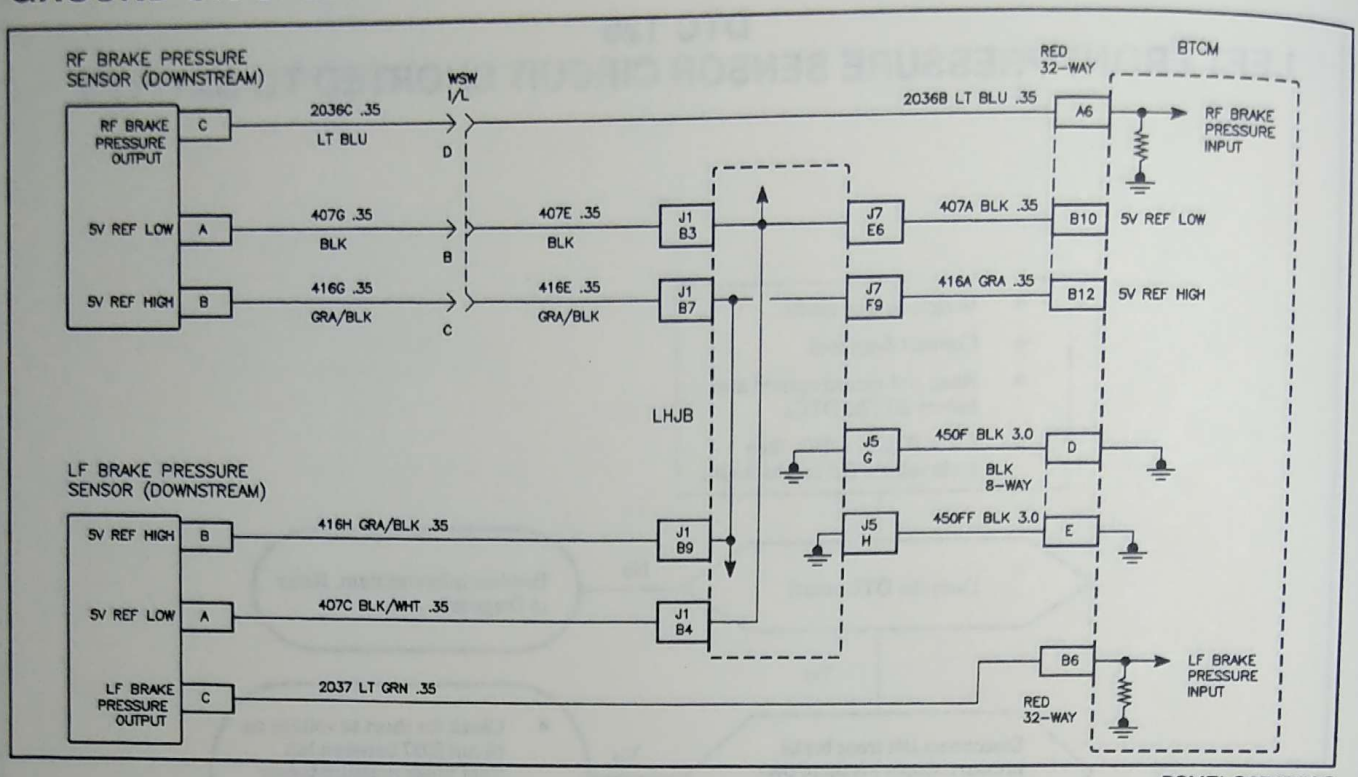
If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 126
LEFT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect left front brake pressure sensor - is there over 4.9 volts at pin C of connector in Run mode?
Yes
Check for short to voltage on circuit 2037 between left front brake pressure sensor and BTCM.
If circuit ok, replace BTCM.
No
Replace left front brake pressure sensor.

CamScanner

DTC 127 – RIGHT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN



PSMELC67479AC

RIGHT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN

The brake torque control module (BTCM) receives downstream pressure information via the two downstream or front pressure transducers. If a sensor fails the BTCM suspends front ABS and power assist and turns On the BRAKE and ANTILOCK telltales.

DTC PARAMETERS

DTC 127 will set if:

- Open or short to ground in the pressure sensor signal circuit.
- Open or short to ground in the 5 volt reference circuit.
- Internal pressure sensor failure.

DTC 127 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is less than 0.14 volts.

FAILURE ACTION

If this failure is detected, the BTCM will cause the front brakes to revert to manual operation, and disable front ABS. The rear brake system and regen will function normally

RELATED DTCS

BTCM 121, 123 and 127.

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

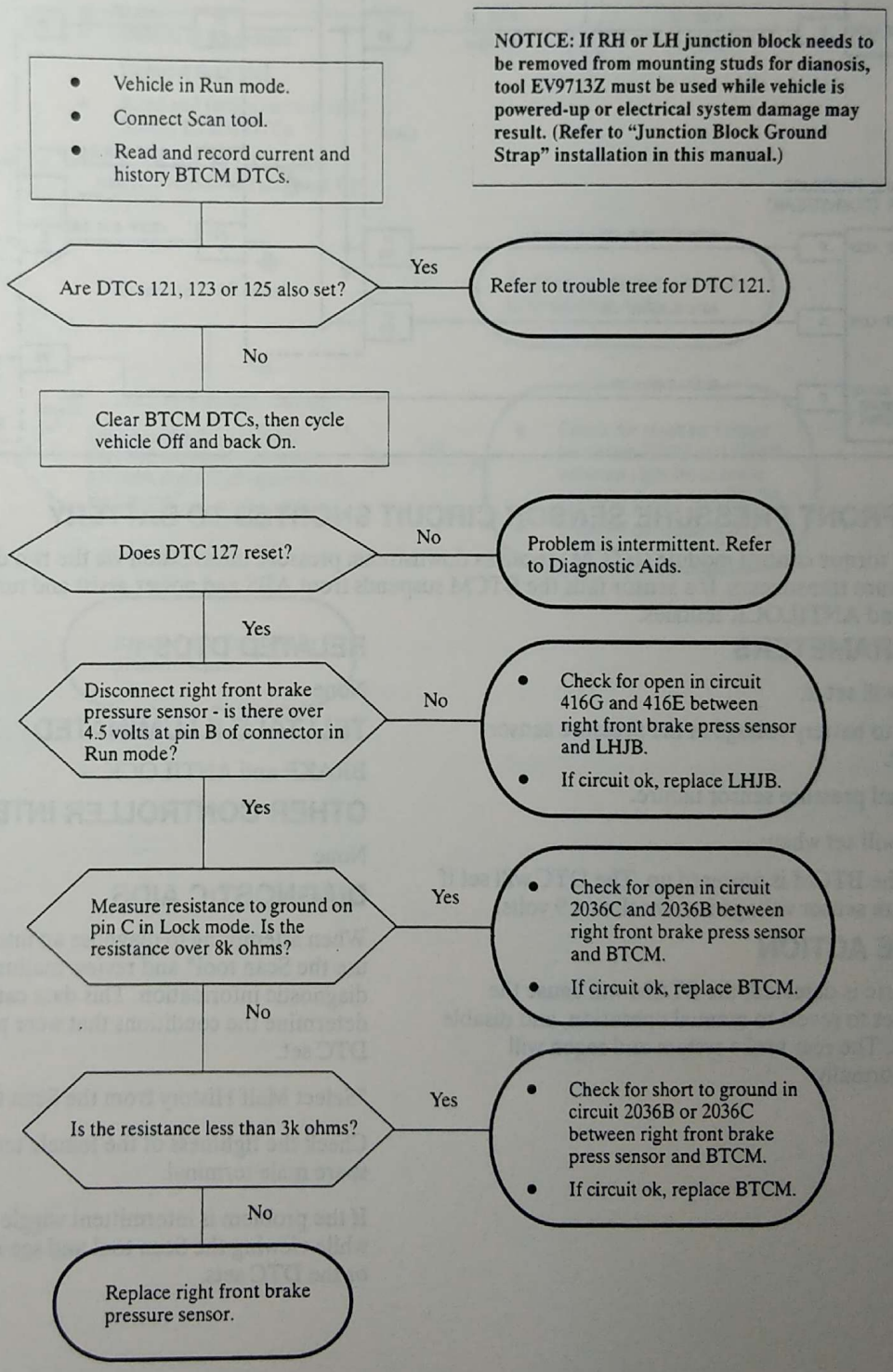
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

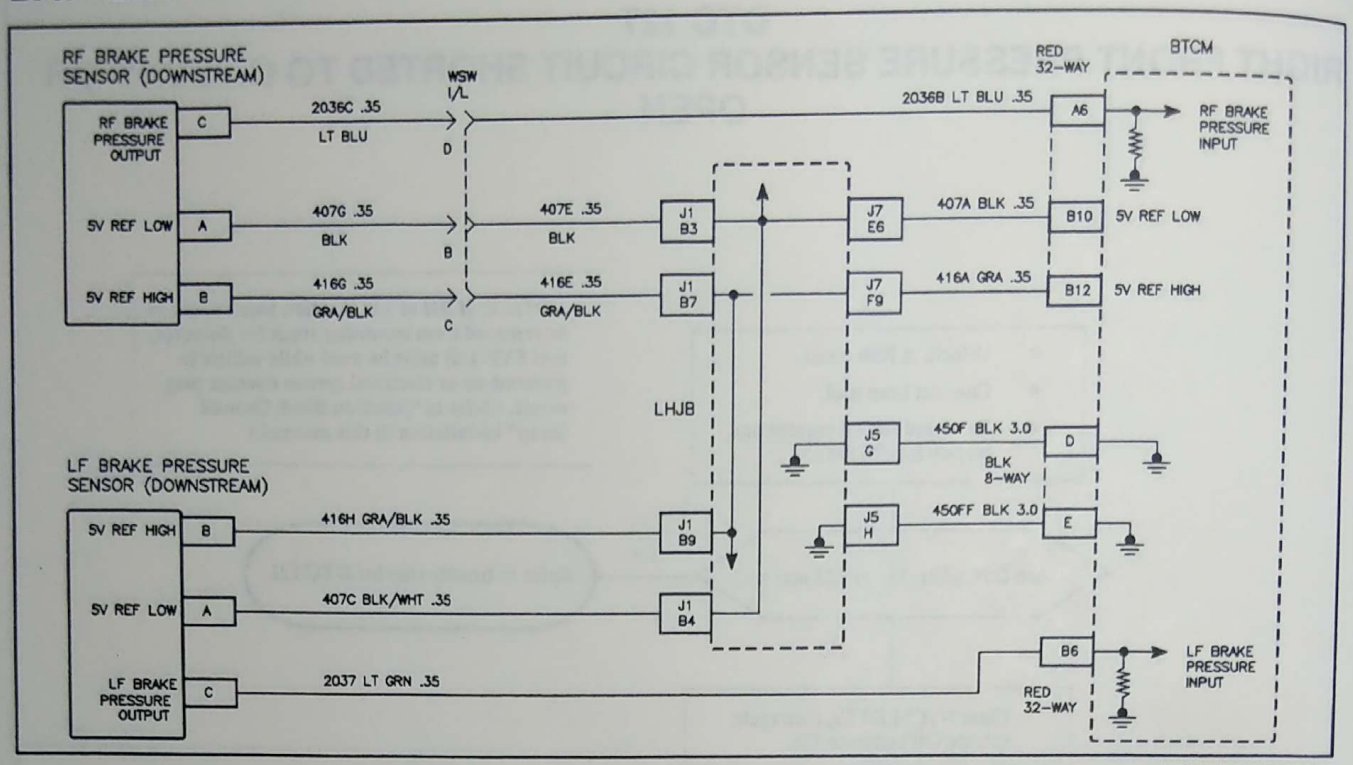
CamScanner

DTC 127
RIGHT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO GROUND OR OPEN


NOTICE: If RH or LH junction block needs to be removed from mounting studs for dianosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)
Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are DTCs 121, 123 or 125 also set?
Yes
Refer to trouble tree for DTC 121.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does DTC 127 reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect right front brake pressure sensor - is there over 4.5 volts at pin B of connector in Run mode?
No
Check for open in circuit 416G and 416E between right front brake press sensor and LHJB.
If circuit ok, replace LHJB.
Yes
Measure resistance to ground on pin C in Lock mode. Is the resistance over 8k ohms?
Yes
Check for open in circuit 2036C and 2036B between right front brake press sensor and BTCM.
If circuit ok, replace BTCM.
No
Is the resistance less than 3k ohms?
Yes
Check for short to ground in circuit 2036B or 2036C between right front brake press sensor and BTCM.
If circuit ok, replace BTCM.
No
Replace right front brake pressure sensor.

CamScanner

DTC 128 – RIGHT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY



PSMELC67479AC

RIGHT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) receives downstream pressure information via the two downstream or front pressure transducers. If a sensor fails the BTCM suspends front ABS and power assist and turns On the BRAKE and ANTILOCK telltales.

DTC PARAMETERS

DTC 128 will set if:

- Short to battery voltage in the pressure sensor circuit.
- Internal pressure sensor failure.

DTC 128 will set when:

Anytime the BTCM is powered up. The DTC will set if the pressure sensor voltage is more than 4.9 volts.

FAILURE ACTION

If this failure is detected, the BTCM will cause the front brakes to revert to manual operation, and disable front ABS. The rear brake system and regen will function normally

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

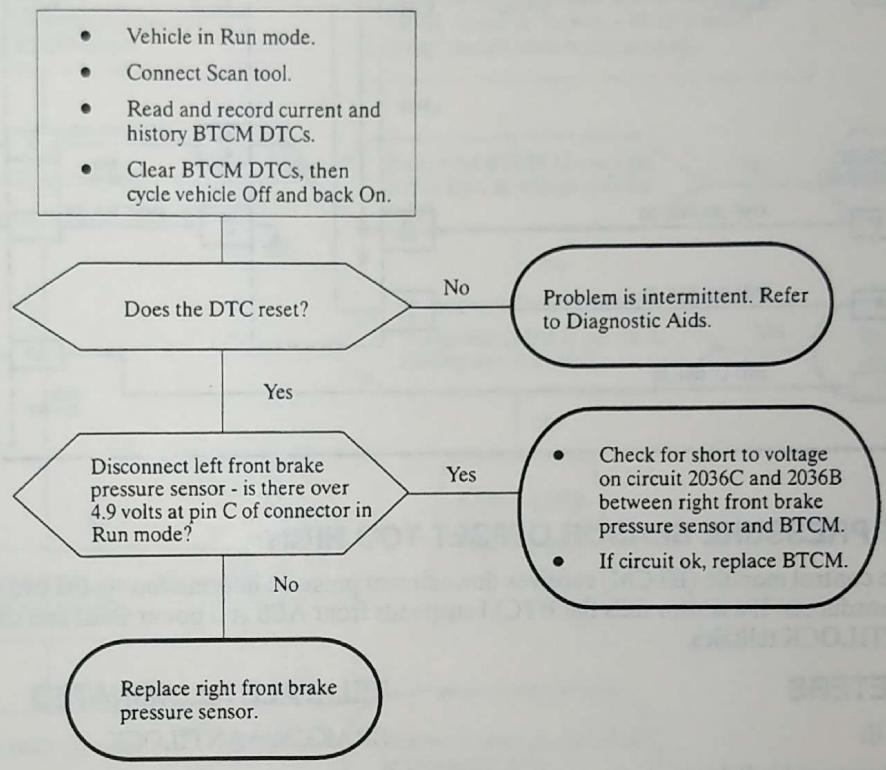
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 128
RIGHT FRONT PRESSURE SENSOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect left front brake pressure sensor - is there over 4.9 volts at pin C of connector in Run mode?
Yes
Check for short to voltage on circuit 2036C and 2036B between right front brake pressure sensor and BTCM.
If circuit ok, replace BTCM.
No
Replace right front brake pressure sensor.

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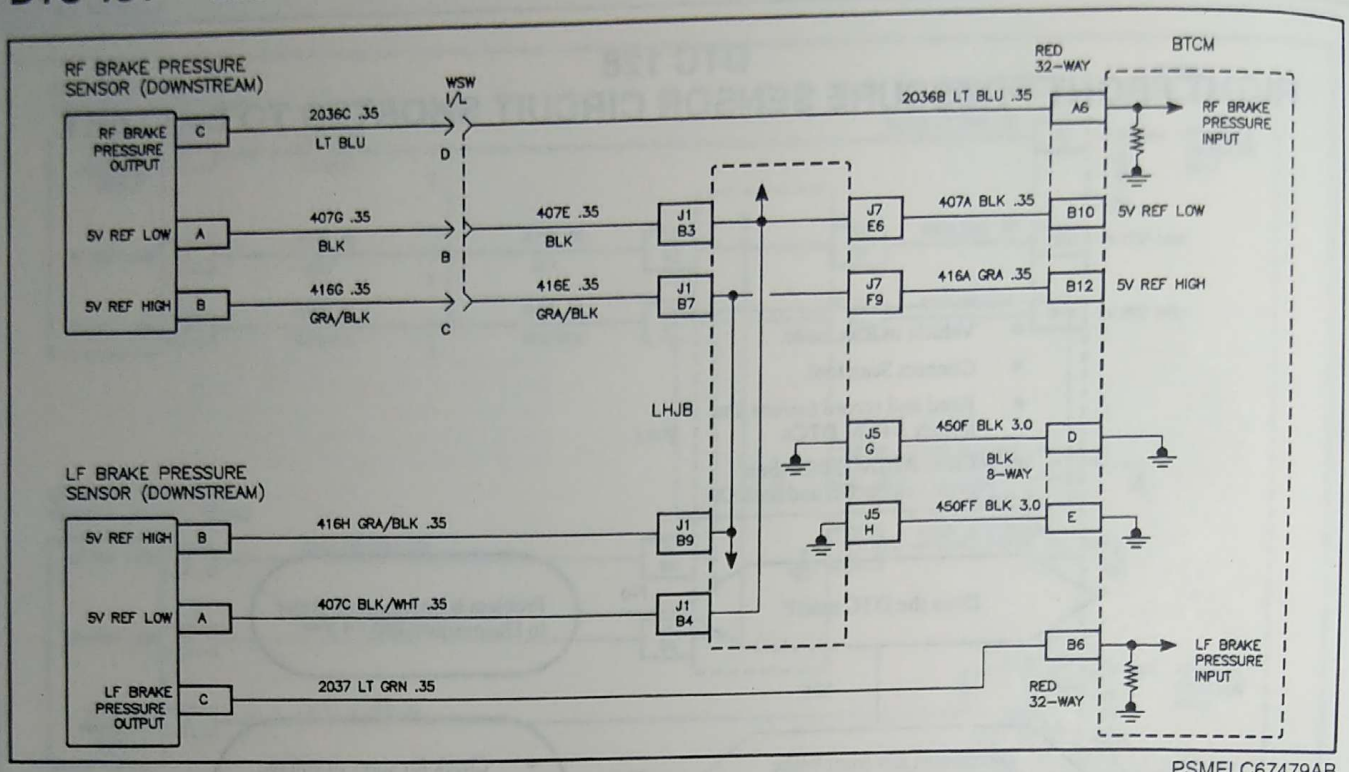
DTC 131 – LEFT FRONT PRESSURE SENSOR OFFSET TOO HIGH



PSMELC67479AB

LEFT FRONT PRESSURE SENSOR OFFSET TOO HIGH

The brake torque control module (BTCM) receives downstream pressure information via the two downstream or front pressure transducers. If a sensor fails the BTCM suspends front ABS and power assist and turns On the BRAKE and ANTILOCK telltales.

DTC PARAMETERS

DTC 131 will set if:

- Internal pressure sensor failure.
- High resistance or open reference low circuit.

DTC 131 will set when:

Anytime the BTCM is powered up, and braking is not being requested. The DTC will set if the pressure sensor voltage is greater than 0.716 volts.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

BTCM 132 and 143.

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

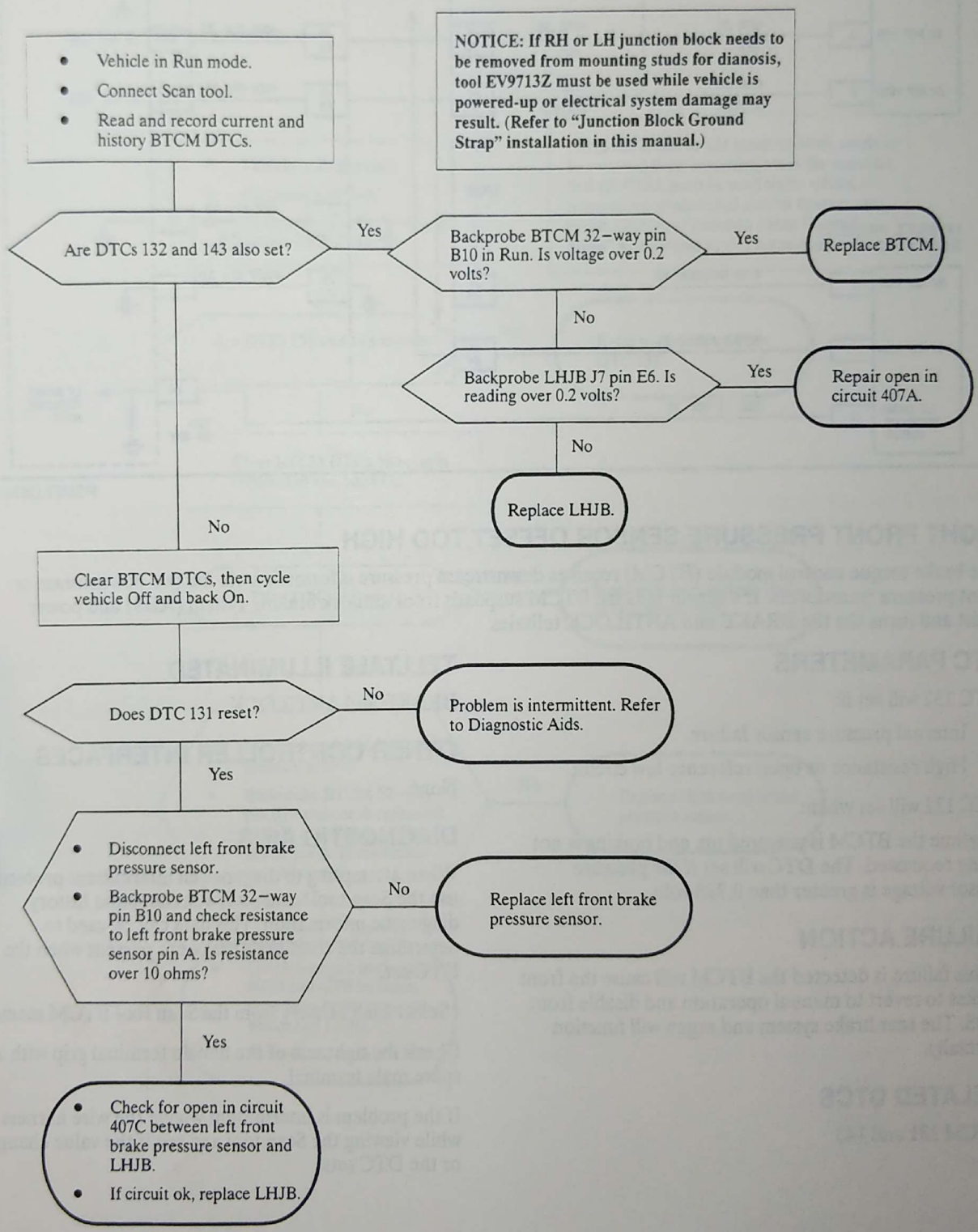
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

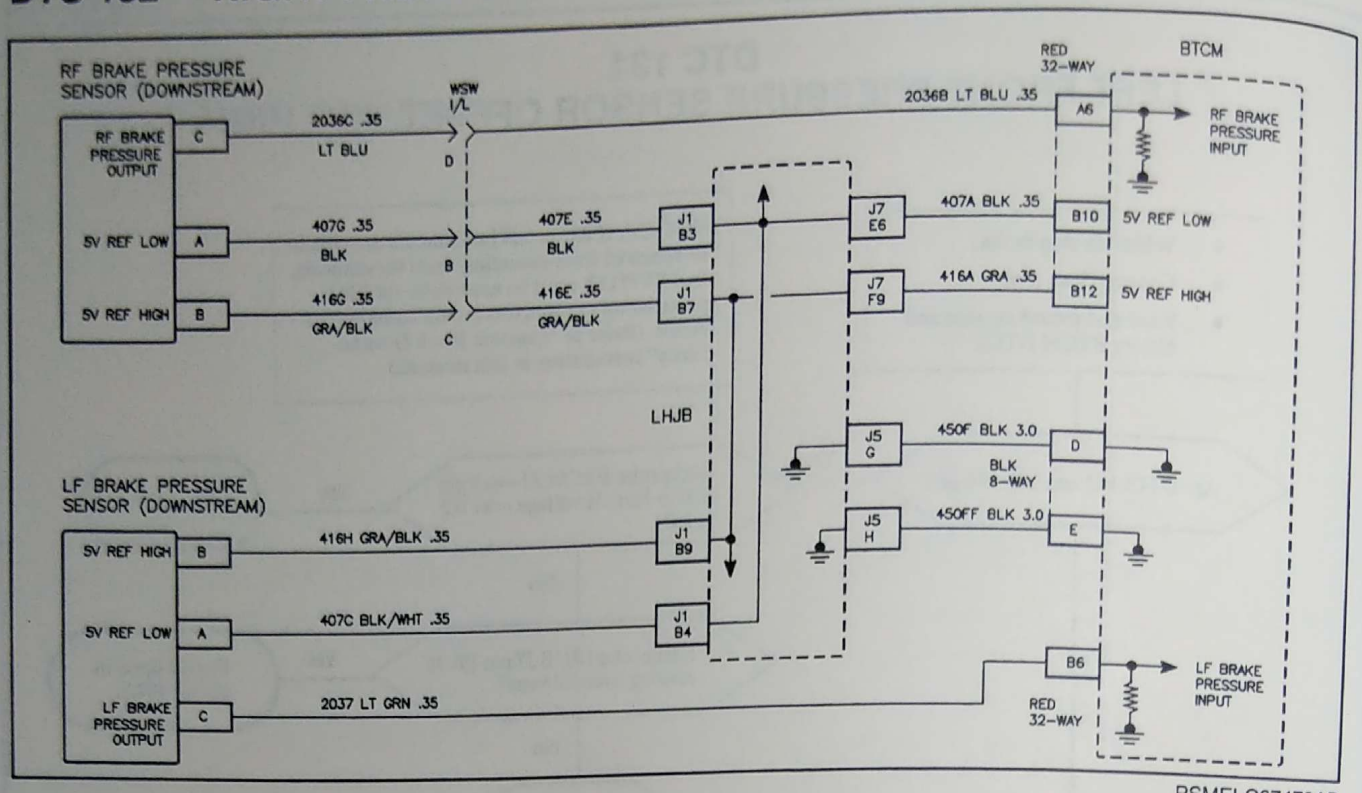
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 131
LEFT FRONT PRESSURE SENSOR OFFSET TOO HIGH


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record current and history BTCM DTCs.
NOTICE: If RH or LH junction block needs to be removed from mounting studs for dianosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)
Are DTCs 132 and 143 also set?
Yes
Backprobe BTCM 32−way pin B10 in Run. Is voltage over 0.2 volts?
Yes
Replace BTCM.
No
Backprobe LHJB J7 pin E6. Is reading over 0.2 volts?
Yes
Repair open in circuit 407A.
No
Replace LHJB.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does DTC 131 reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
• Disconnect left front brake pressure sensor.
• Backprobe BTCM 32−way pin B10 and check resistance to left front brake pressure sensor pin A. Is resistance over 10 ohms?
No
Replace left front brake pressure sensor.
Yes
• Check for open in circuit 407C between left front brake pressure sensor and LHJB.
• If circuit ok, replace LHJB.

DTC 132 – RIGHT FRONT PRESSURE SENSOR OFFSET TOO HIGH



PSMELC67479AB

RIGHT FRONT PRESSURE SENSOR OFFSET TOO HIGH

The brake torque control module (BTCM) receives downstream pressure information via the two downstream or front pressure transducers. If a sensor fails the BTCM suspends front antilock braking system (ABS) and power assist and turns On the BRAKE and ANTILOCK telltales.

DTC PARAMETERS

DTC 132 will set if:

- Internal pressure sensor failure.
- High resistance or open reference low circuit.

DTC 132 will set when:

Anytime the BTCM is powered up, and braking is not being requested. The DTC will set if the pressure sensor voltage is greater than 0.716 volts.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally.

RELATED DTCS

BTCM 131 and 143

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

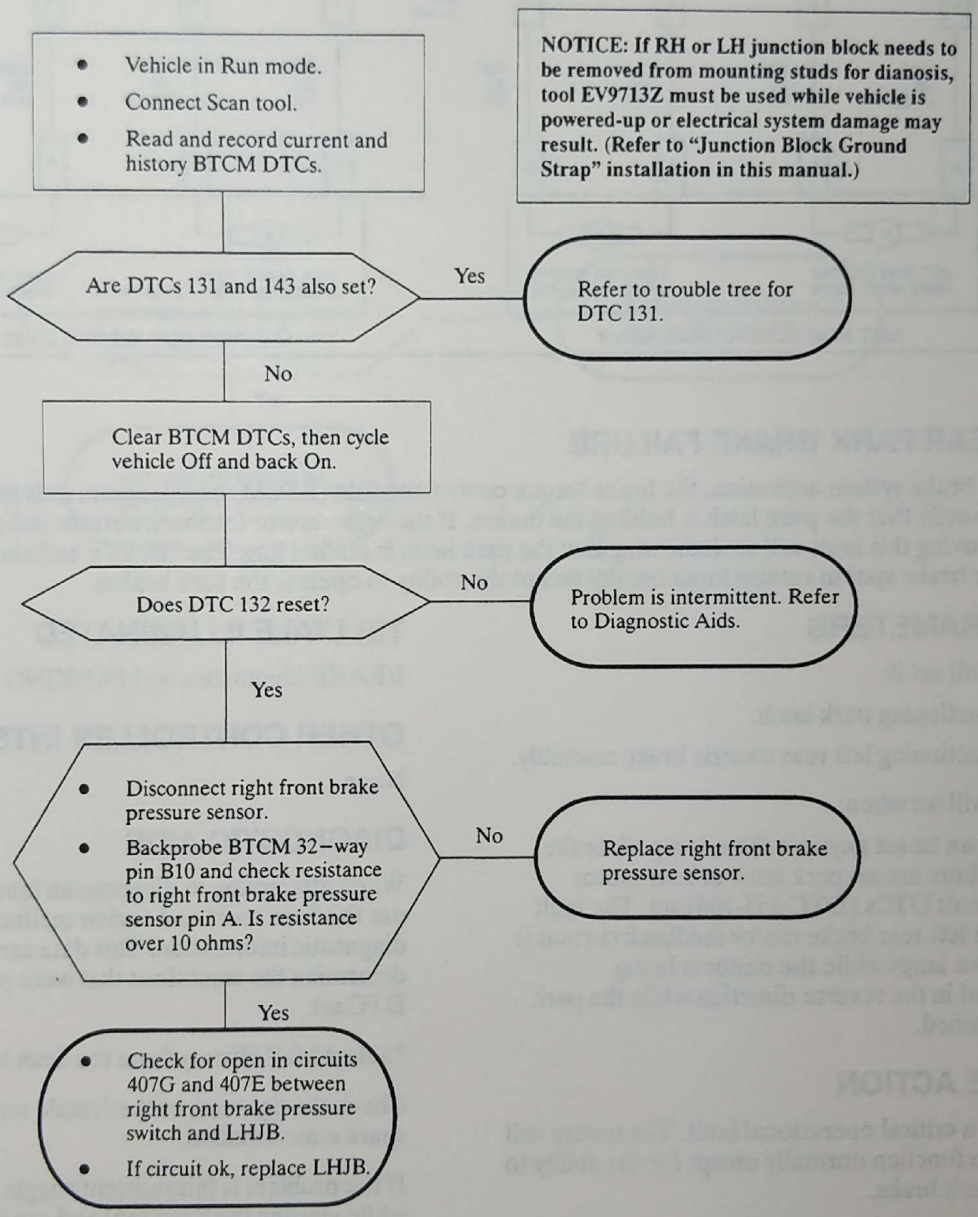
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

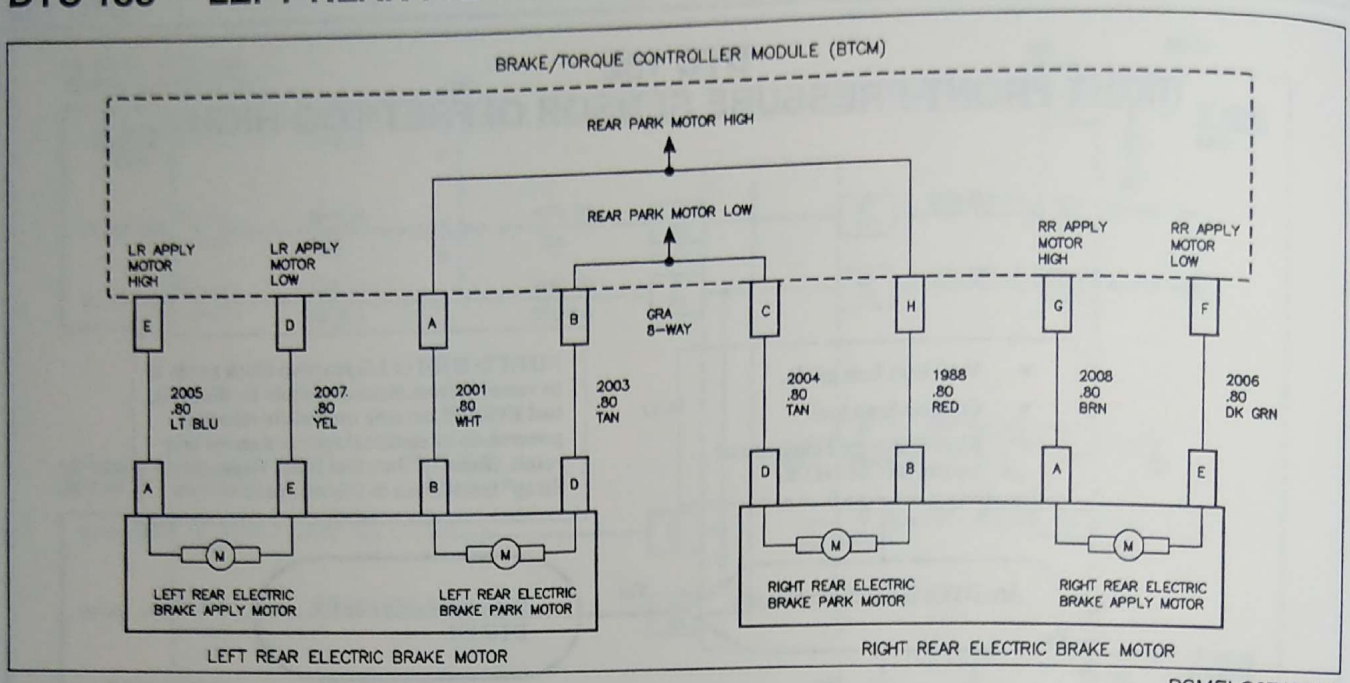
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 132
RIGHT FRONT PRESSURE SENSOR OFFSET TOO HIGH


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record current and history BTCM DTCs.
NOTICE: If RH or LH junction block needs to be removed from mounting studs for dianosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)
Are DTCs 131 and 143 also set?
Yes
Refer to trouble tree for DTC 131.
No
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does DTC 132 reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
• Disconnect right front brake pressure sensor.
• Backprobe BTCM 32−way pin B10 and check resistance to right front brake pressure sensor pin A. Is resistance over 10 ohms?
No
Replace right front brake pressure sensor.
Yes
• Check for open in circuits 407G and 407E between right front brake pressure switch and LHJB.
• If circuit ok, replace LHJB.

DTC 133 – LEFT REAR PARK BRAKE FAILURE


BRAKE/TORQUE CONTROLLER MODULE (BTCM)
REAR PARK MOTOR HIGH
REAR PARK MOTOR LOW
LR APPLY MOTOR HIGH
LR APPLY MOTOR LOW
RR APPLY MOTOR HIGH
RR APPLY MOTOR LOW
GRA 8-WAY
2005 .80 LT BLU
2007 .80 YEL
2001 .80 WHT
2003 .80 TAN
2004 .80 TAN
1988 .80 RED
2008 .80 BRN
2006 .80 DK GRN
LEFT REAR ELECTRIC BRAKE APPLY MOTOR
LEFT REAR ELECTRIC BRAKE PARK MOTOR
RIGHT REAR ELECTRIC BRAKE PARK MOTOR
RIGHT REAR ELECTRIC BRAKE APPLY MOTOR
LEFT REAR ELECTRIC BRAKE MOTOR
RIGHT REAR ELECTRIC BRAKE MOTOR

PSMELC67480AA

LEFT REAR PARK BRAKE FAILURE

After park brake system activation, the brake torque control module (BTCM) briefly commands the rear brakes in reverse to verify that the park latch is holding the brakes. If the brake motor feedback current indicates that the motor is moving this fault will set indicating that the park latch is not holding. The BRAKE telltale will be turned On and the brake system retains functionality except the ability to operate the park brakes.

DTC PARAMETERS

DTC 133 will set if:

- Malfunctioning park latch.
- Malfunctioning left rear electric brake assembly.

DTC 133 will set when:

This fault can be set anytime there is a park brake request if there are no park latch or rear motor electrical fault DTCs (DTC 155-166) set. The fault exists if the left rear brake motor feedback current is less than five amps while the motor is being commanded in the reverse direction while the park brake is latched.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally except for the ability to latch the park brake.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE illuminates and PARKING BRAKE flashes.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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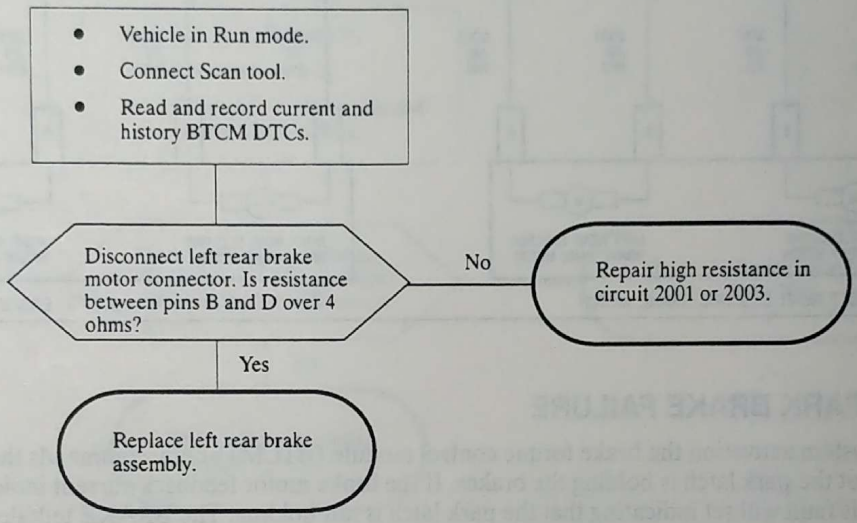
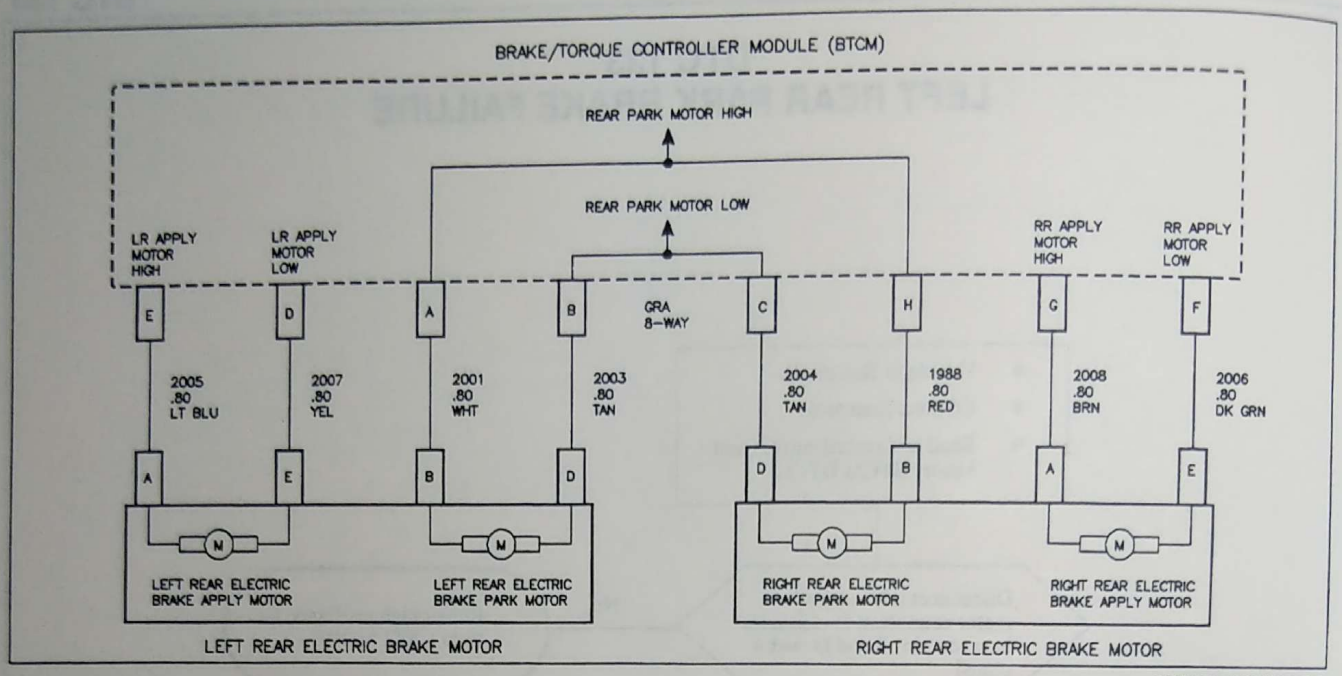
DTC 133
LEFT REAR PARK BRAKE FAILURE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Disconnect left rear brake motor connector. Is resistance between pins B and D over 4 ohms?
No
Repair high resistance in circuit 2001 or 2003.
Yes
Replace left rear brake assembly.

CamScanner

DTC 134 – RIGHT REAR PARK BRAKE FAILURE



PSMELC67480AA

RIGHT REAR PARK BRAKE FAILURE

After park brake system activation the brake torque control module (BTCM) briefly commands the rear brakes in reverse to verify that the park latch is holding the brakes. If the brake motor feedback current indicates that the motor is moving this fault will set indicating that the park latch is not holding. The BRAKE telltale will be turned On and all brake system functionality will be maintained.

DTC PARAMETERS

DTC 134 will set if:

- Malfunctioning park latch.
- Malfunctioning left rear electric brake assembly.

DTC 134 will set when:

This fault can be set anytime there is a park brake request if there are no park latch or rear motor electrical fault DTCs (DTC 155-166) set. The fault exists if the right rear brake motor feedback current is less than five amps while the motor is being commanded in the reverse direction while the park brake is latched.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally except for the ability to latch the park brake.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE illuminates and PARKING BRAKE flashes.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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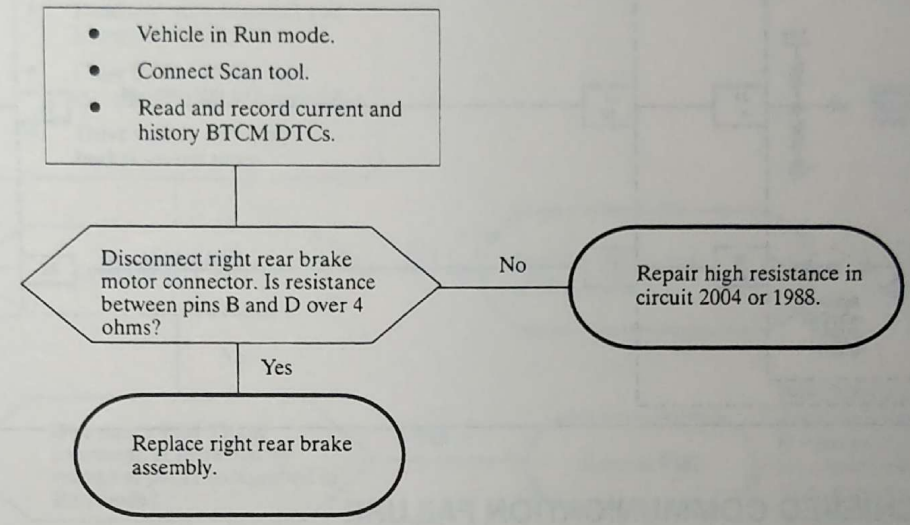
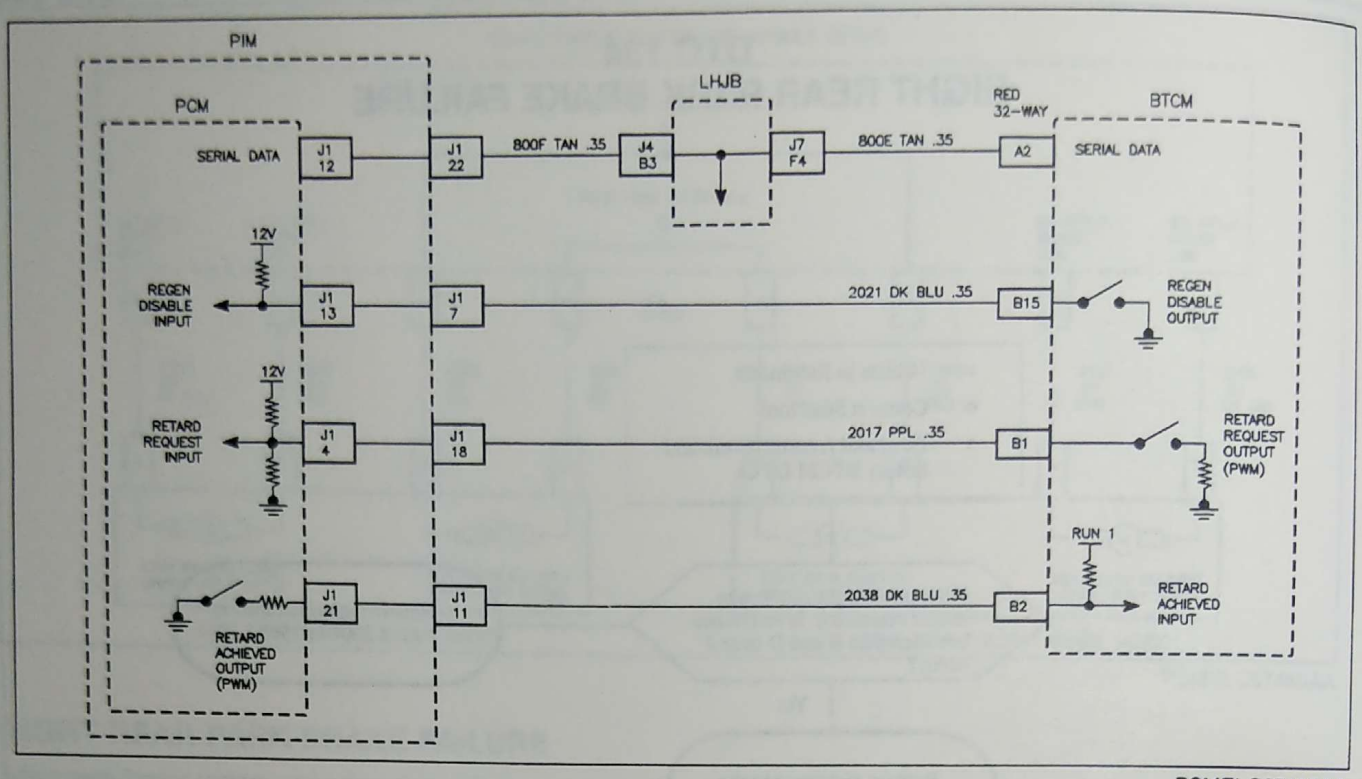
DTC 134
RIGHT REAR PARK BRAKE FAILURE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Disconnect right rear brake motor connector. Is resistance between pins B and D over 4 ohms?
No
Repair high resistance in circuit 2004 or 1988.
Yes
Replace right rear brake assembly.

CamScanner

DTC 141 – REGEN ACHIEVED COMMUNICATION FAILURE



PSMELC67482AA

REGEN ACHIEVED COMMUNICATION FAILURE

The brake torque control module (BTCM) receives a pulse width modulated signal from the PCM over the regen achieved line. If this signal is lost the BTCM will turn On the service soon telltale. Normal braking function will continue except for the ability to perform regen braking.

DTC PARAMETERS

DTC 141 will set if:

Open, or short to ground or battery voltage on the Regen achieved circuit.

DTC141 will set when:

Anytime Run 1 is present. This fault exists if no PWM signal (on the regen achieved line) is detected by the BTCM.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally but there will be no regen blended into braking. This is a recoverable fault which means that if the failure conditions are intermittent regen will resume when the failure conditions are not present.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

This DTC will be set during PCM reprogramming.

This DTC will be set due to PCM communication failures.

This DTC may set if the PCM undergoes a running reset (PCM 76).

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

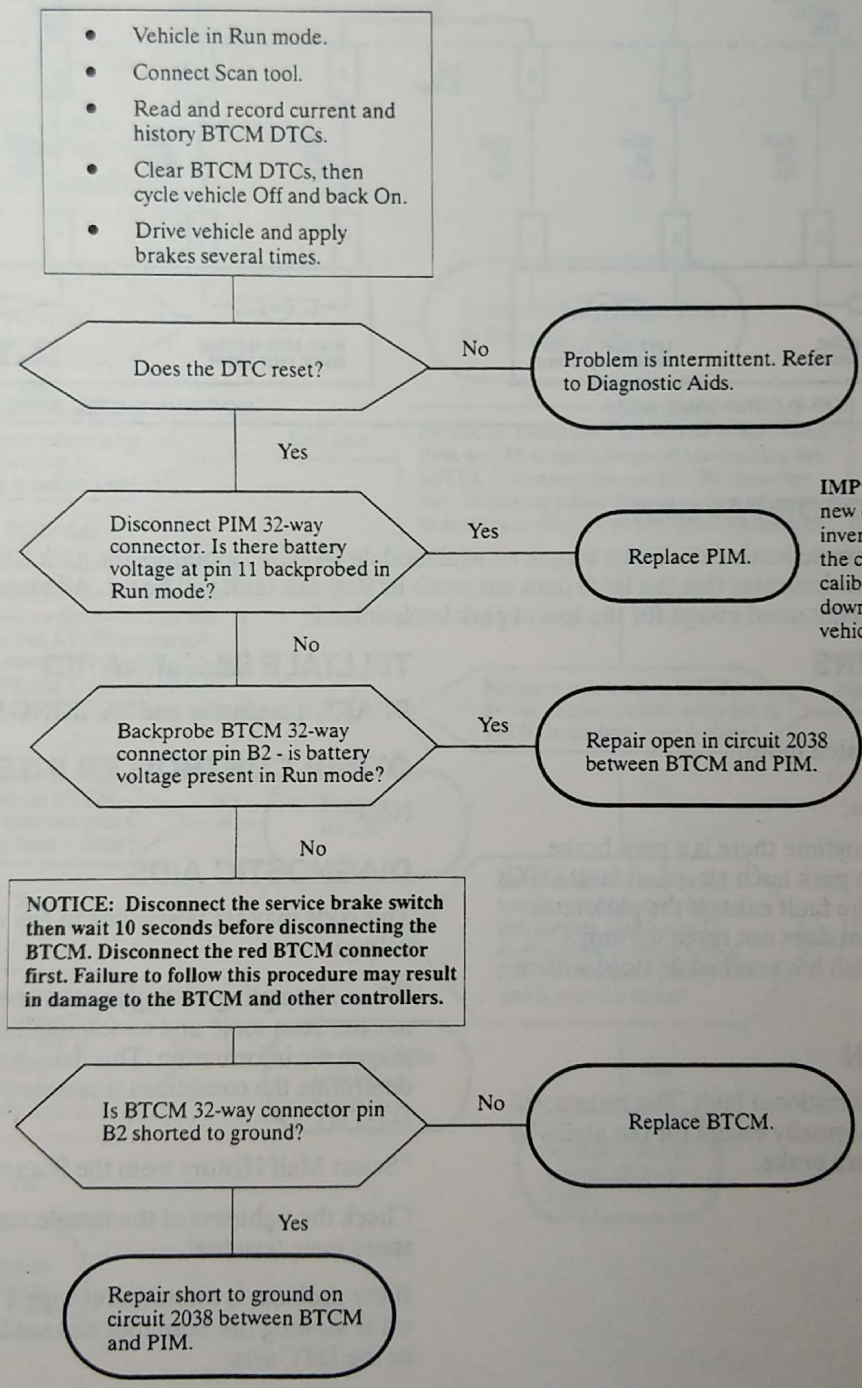
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

CamScanner

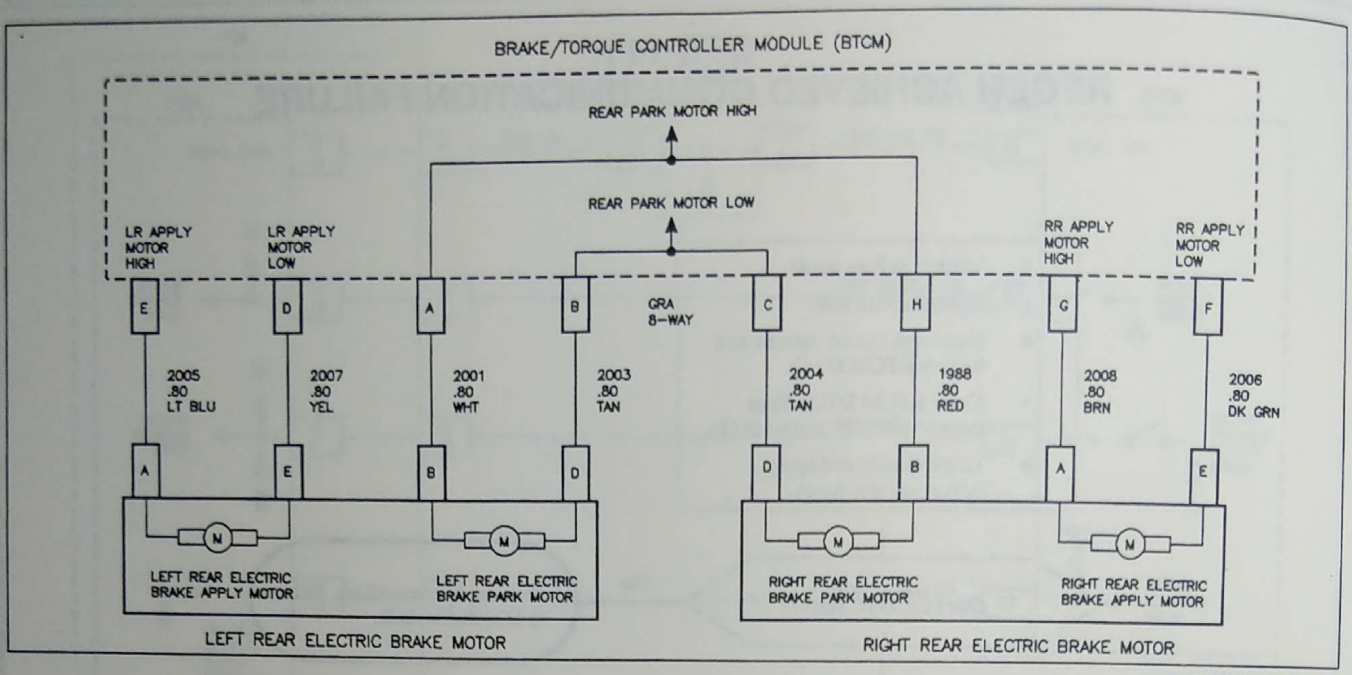
DTC 141
REGEN ACHIEVED COMMUNICATION FAILURE


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Drive vehicle and apply brakes several times.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Disconnect PIM 32-way connector. Is there battery voltage at pin 11 backprobed in Run mode?
Yes
Replace PIM.
No
Backprobe BTCM 32-way connector pin B2 - is battery voltage present in Run mode?
Yes
Repair open in circuit 2038 between BTCM and PIM.
No
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is BTCM 32-way connector pin B2 shorted to ground?
No
Replace BTCM.
Yes
Repair short to ground on circuit 2038 between BTCM and PIM.

IMPORTANT: When a new drive motor power inverter module is installed the correct software and calibrations to be downloaded before the vehicle will operate.

CamScanner

DTC 142 – PARK LATCH MOTOR FAILURE



PSMELC67480AA

PARK LATCH MOTOR FAILURE

After park brake system activation the brake torque control module (BTCM) monitors the park latch feedback current. If the feedback indicates that the latch does not reach its stop this fault will be set. All brake system functionality will be maintained except for the loss of park latch/unlatch.

DTC PARAMETERS

DTC 142 will set if:

Malfunctioning park latch motor.

DTC 142 will set when:

This fault can be set anytime there is a park brake request if there are no park latch electrical fault DTCs (DTC 164-166) set. The fault exists if the park latch motor feedback current does not reach 6.0 amps (indicating that the latch has reached its stop) within 200 milliseconds.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally except for the ability to latch or unlatch the park brake.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE illuminates and PARKING BRAKE flashes.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

This code may set falsely due to low auxiliary battery voltage.

When attempting to diagnose an intermittent problem use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 142
PARK LATCH MOTOR FAILURE

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.
- Cycle park brake On and Off.

Does DTC 142 reset?

No → Problem is intermittent. Refer to Diagnostic Aids.

Yes

With the park brake selected try to spin both rear wheels by hand. Which side is not locked?

Left side → **NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.**

Right side → **NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.**

Measure resistance at BTCM 8-way connector between pins C and H. Is reading. over 4 ohms?

No → Replace BTCM.

Yes

Disconnect right rear brake motor assembly connector and jumper pins B and D. Is resistance reading between BTCM connector pins C and H over 2 ohms?

No → Replace right rear brake assembly.

Yes

Repair open in circuit 2004 or 1988.

Measure resistance at BTCM 8-way connector between pins A and B. Is reading. over 4 ohms?

No → Replace BTCM.

Yes

Disconnect left rear brake motor assembly connector and jumper pins B and D. Is resistance reading across BTCM connector pins A and B over 2.0 ohms?

No → Replace leftt rear brake assembly.

Yes

Repairs open in circuit 2001 or 2003.

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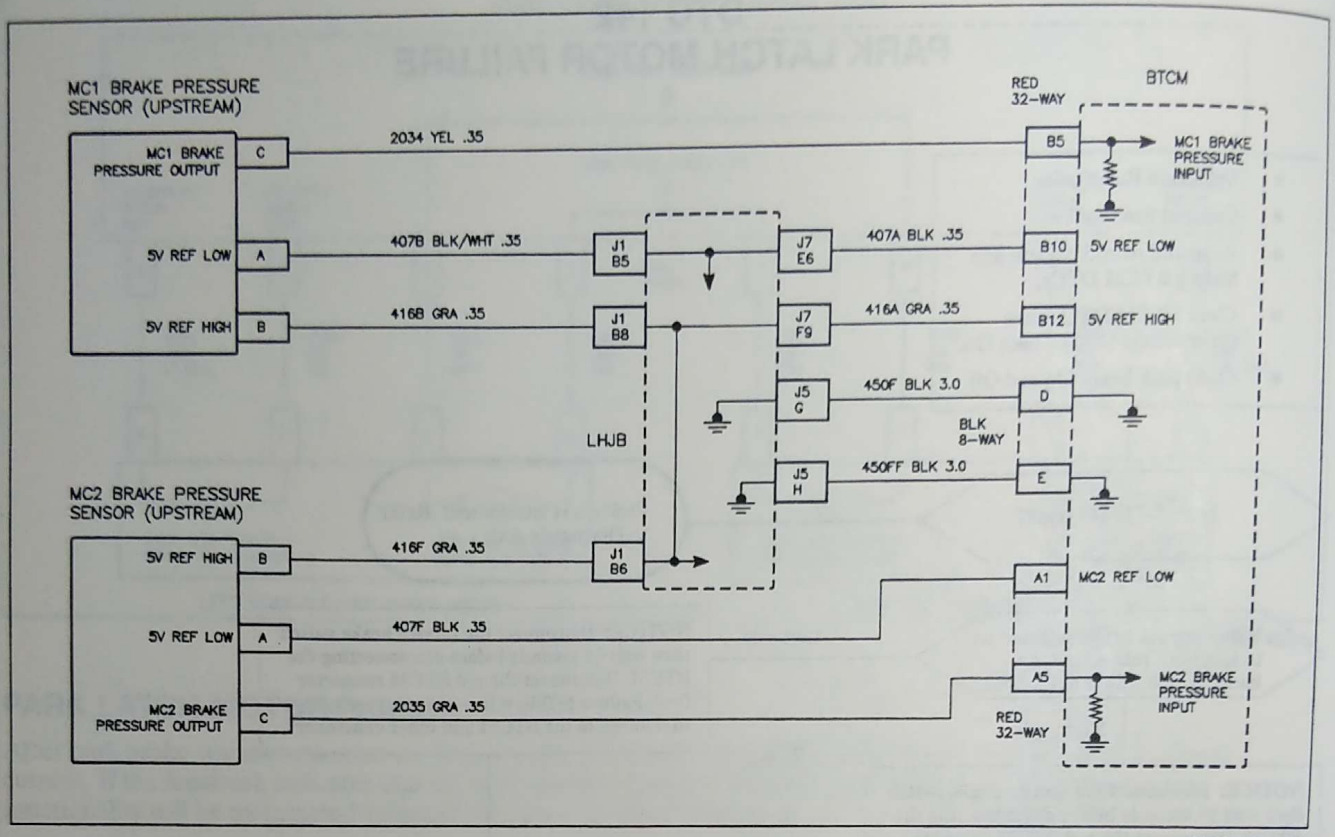
DTC 143 – MASTER CYLINDER PRESSURE SENSOR (UPSTREAM) DIFFERENTIAL TOO LARGE



PSMELC67478AC

MASTER CYLINDER PRESSURE SENSOR (UPSTREAM) DIFFERENTIAL TOO LARGE

The brake torque control module (BTCM) receives driver brake request input via the two master cylinder (upstream) pressure transducers. The sensors should indicate similar readings throughout their operational range. If the BTCM detects an excessive difference between the two sensors it will disable front power assist, front ABS and turn On the BRAKE and ANTILOCK telltale.

DTC PARAMETERS

DTC 143 will set if:

- Internal pressure sensor failure.
- Brake system hydraulic leak.
- MC1 reference low open.
- MC2 reference low open.
- Master cylinder failure.
- Pedal feel emulator.

DTC 143 will set when:

Anytime the BTCM is powered up and no DTC 121, 122, 123 or 124 has been set. The DTC will set if the voltage difference between the two pressure sensors is more than 0.490 volts for more than 500 milliseconds.

FAILURE ACTION

If this failure is detected the BTCM will cause the front brakes to revert to manual operation and disable front ABS. The rear brake system and regen will function normally. Brake pedal travel will increase.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 143
MASTER CYLINDER PRESSURE SENSOR (UPSTREAM) DIFFERENTIAL TOO LARGE

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Clear BTCM DTCs, then cycle vehicle Off and back On.
- Firmly press brake pedal for 10 seconds.

NOTICE: If RH or LH junction block needs to be removed from mounting studs for dianosis, tool EV9713Z must be used while vehicle is powered-up or electrical system damage may result. (Refer to "Junction Block Ground Strap" installation in this manual.)

Are DTCs 131 and 132 also set?
- Yes → Refer to DTC 131 troubletree.
- No →

Does the DTC reset?
- No → Problem is intermittent. Refer to Diagnostic Aids.
- Yes →

- Clean underbody as necessary.
- Use assistant or use scan tool test to maintain heavy brake pressure.
- Inspect for leaks.

Are any leaks present?
- Yes → Repair leaks.
- No →

- Enter Run mode and keep foot off brake during this test.
- In scan tool BTCM general information check MCPS1 and MCPS2.
- Are both pressure sensors reading between 0.45 and 0.55 volts?

- Yes → Replace brake pressure modulator valve assembly.
- No →

MC1 out of range

Disconnect pressure sensor. Is pin A to ground reading more than 2.0 ohms?
- No → Replace MC1 sensor.
- Yes →

- Check for open in circuit 407B between pressure sensor and LHJB.
- If circuit ok, replace LHJB.

MC2 out of range

Disconnect pressure sensor. Is pin A to ground reading more than 2.0 ohms?
- No → Replace MC2 sensor.
- Yes →

- Check for open in circuit 407F between pressure sensor and BTCM.
- If circuit ok, replace BTCM.

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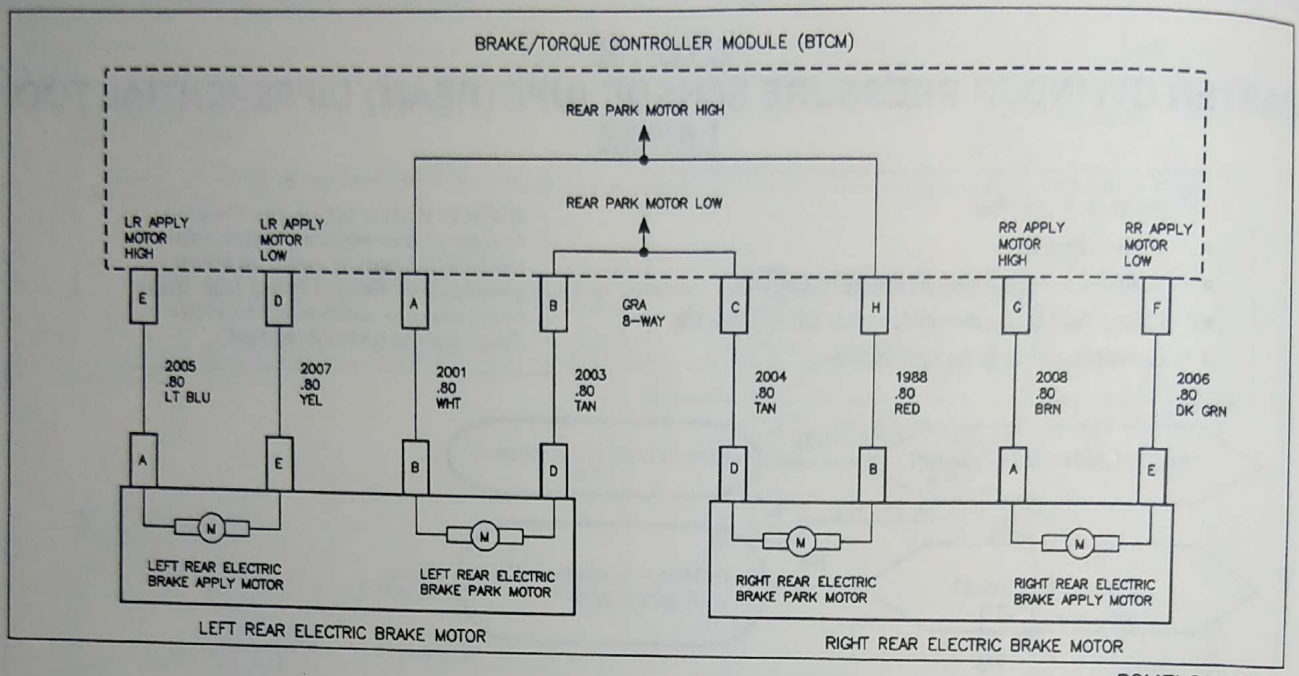
DTC 147 – LEFT REAR MOTOR FREE SPINS



PSMELC67480AA

LEFT REAR MOTOR FREE SPINS

The brake torque control module (BTCM) monitors rear brake feedback current whenever a rehome or park apply is being performed. If the brake motor feedback current indicates that the motor is spinning freely (indicating little or no mechanical resistance) this fault will set. The BRAKE and ANTILOCK telltale will be turned On the failed rear brake and front ABS are disabled.

DTC PARAMETERS

DTC 147 will set if:

Malfunctioning left rear electric brake assembly.

DTC 147 will set when:

This fault can be set anytime the rear enable relay is commanded On and the left rear motor is performing a rehome or a park brake apply. The fault exists if the left rear brake motor feedback current is less than 8.5 amps during a park brake apply or does not reach 6.0 amps during a rehome.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and left rear brake apply. The front brakes, the right rear brake system and regen will function normally

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 147
LEFT REAR MOTOR FREE SPINS

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

If DTC 147 is set it is due to an internal left rear brake assembly fault.

Replace the left rear brake apply motor.

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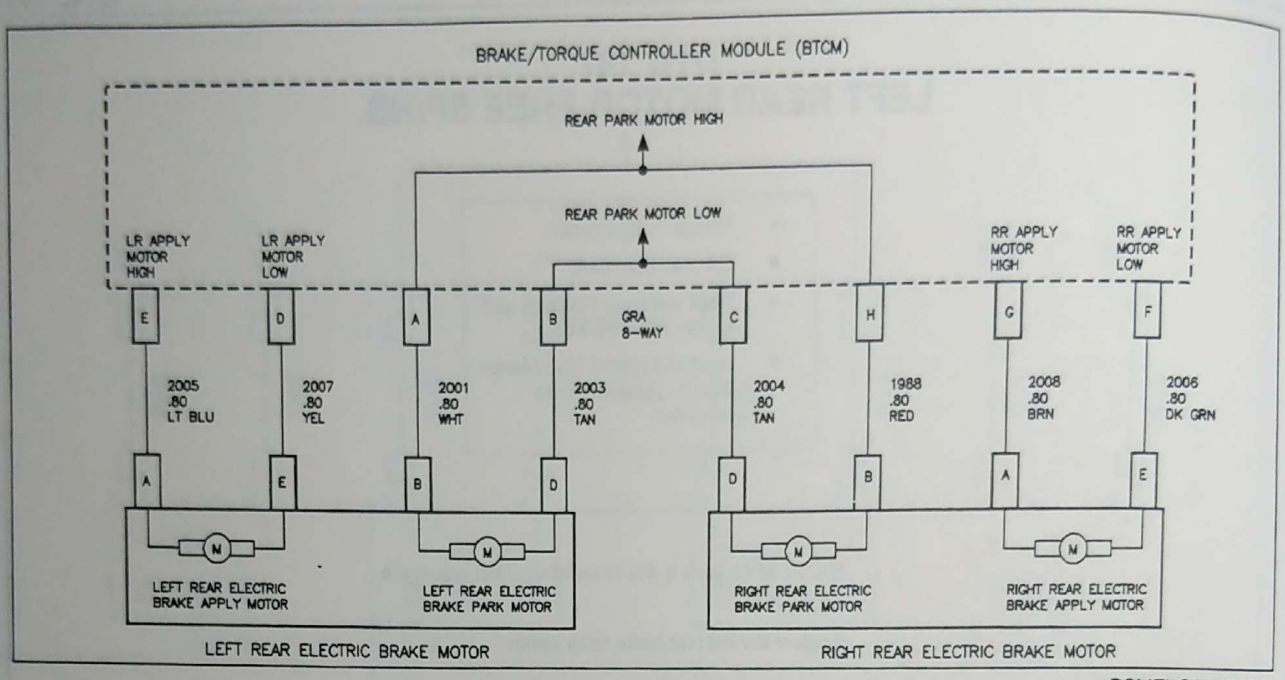
DTC 148 – RIGHT REAR MOTOR FREE SPINS



PSMELC67480AA

RIGHT REAR MOTOR FREE SPINS

The brake torque control module (BTCM) monitors rear brake feedback current whenever a rehome or park apply is being performed. If the brake motor feedback current indicates that the motor is spinning freely (indicating little or no mechanical resistance) this fault will set. The BRAKE and ANTILOCK telltale will be turned On, the failed rear brake and front ABS are disabled.

DTC PARAMETERS

DTC 148 will set if:

Malfunctioning right rear electric brake assembly.

DTC 148 will set when:

This fault can be set anytime the rear enable relay is commanded On and the right rear motor is performing a rehome or a park brake apply. The fault exists if the right rear brake motor feedback current is less than 8.5 amps during a park brake apply or does not reach 6.0 amps during a rehome.

FAILURE ACTION

If this failure is detected the BTCM will disable right rear brake apply, and disable ABS. The front brakes, the left rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 148
RIGHT REAR MOTOR FREE SPINS

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

If DTC 148 is set it is due to an internal right rear brake assembly fault.

Replace the right rear brake apply motor.

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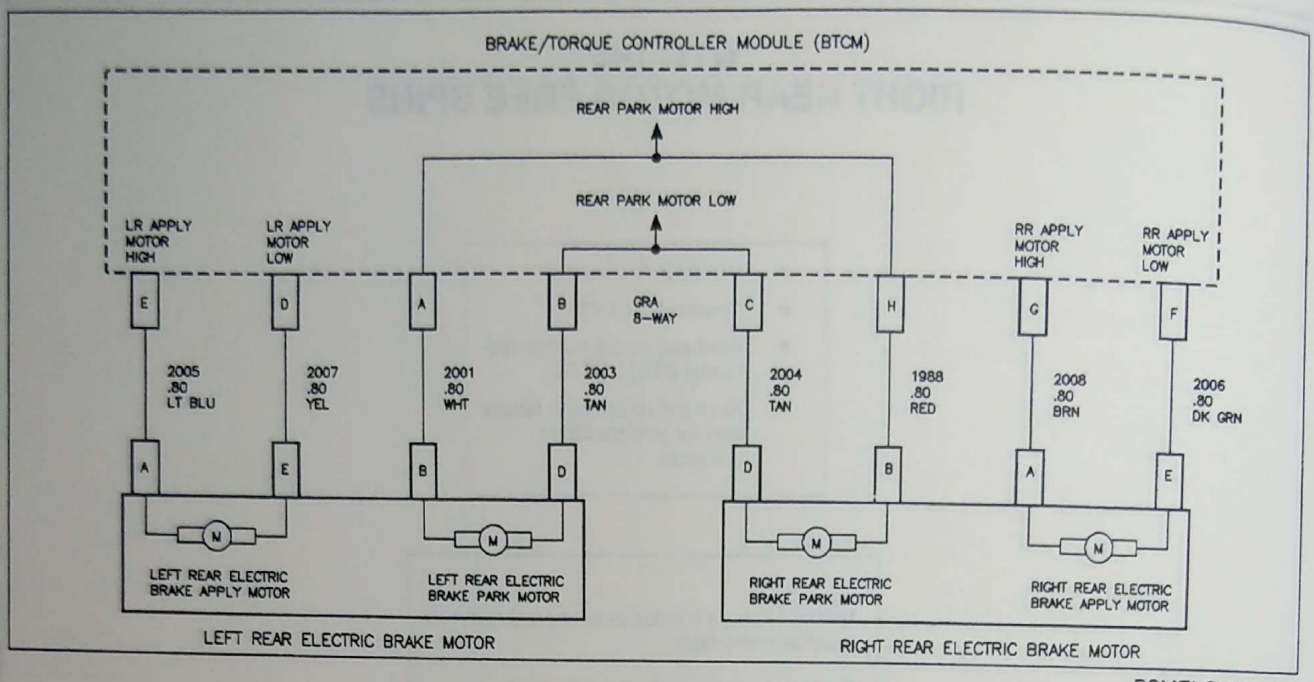
DTC 152 – REAR CHANNEL IN RELEASE TOO LONG DURING ABS



PSMELC67480AA

REAR CHANNEL IN RELEASE TOO LONG DURING ABS

If the rear brake motor indicates release for too long this fault will set. The ANTILOCK telltale will be turned On and front and rear ABS are disabled.

DTC PARAMETERS

DTC 152 will set if:

- Intermittent open motor circuit.
- WSS DTC 23 or 24 conditions present during an ABS stop.
- Base brake dragging.
- Intermittent open left or right rear brake motor assembly.

DTC 152 will set when:

This fault can be set during an ABS stop. The fault exists if ABS is active and the rear brakes are in release for more than two seconds.

FAILURE ACTION

If this failure is detected the brake torque control module (BTCM) will disable front and rear ABS. Front and rear brakes and regen will function normally.

RELATED DTCS

BTCM 23 and 24

TELLTALE ILLUMINATED

ANTILOCK

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

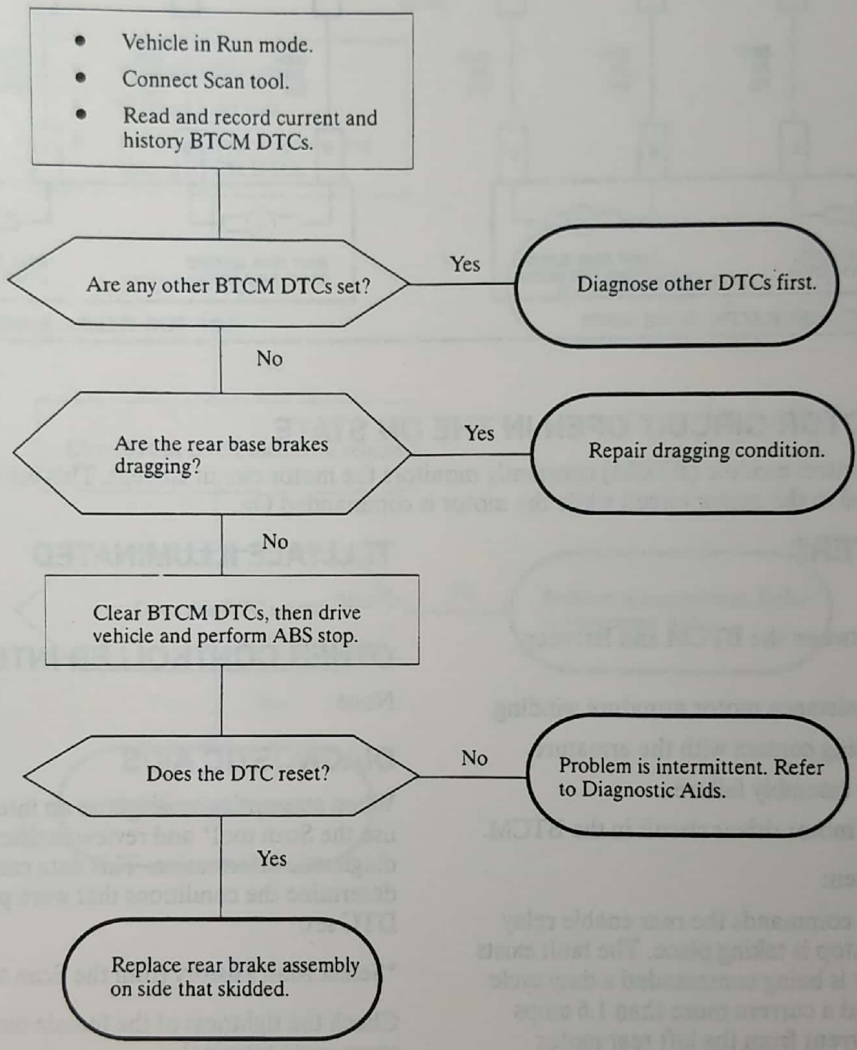
If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

Verify whether vehicle has been driven on extremely slippery surfaces. If yes this DTC may be a normal result of the road condition.

This is the likely cause if malf history indicates fault only occured one time.

Could be caused by noise on WSS.

DTC 152
REAR CHANNEL IN RELEASE TOO LONG DURING ABS


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Are any other BTCM DTCs set?
Yes
Diagnose other DTCs first.
No
Are the rear base brakes dragging?
Yes
Repair dragging condition.
No
Clear BTCM DTCs, then drive vehicle and perform ABS stop.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
Replace rear brake assembly on side that skidded.

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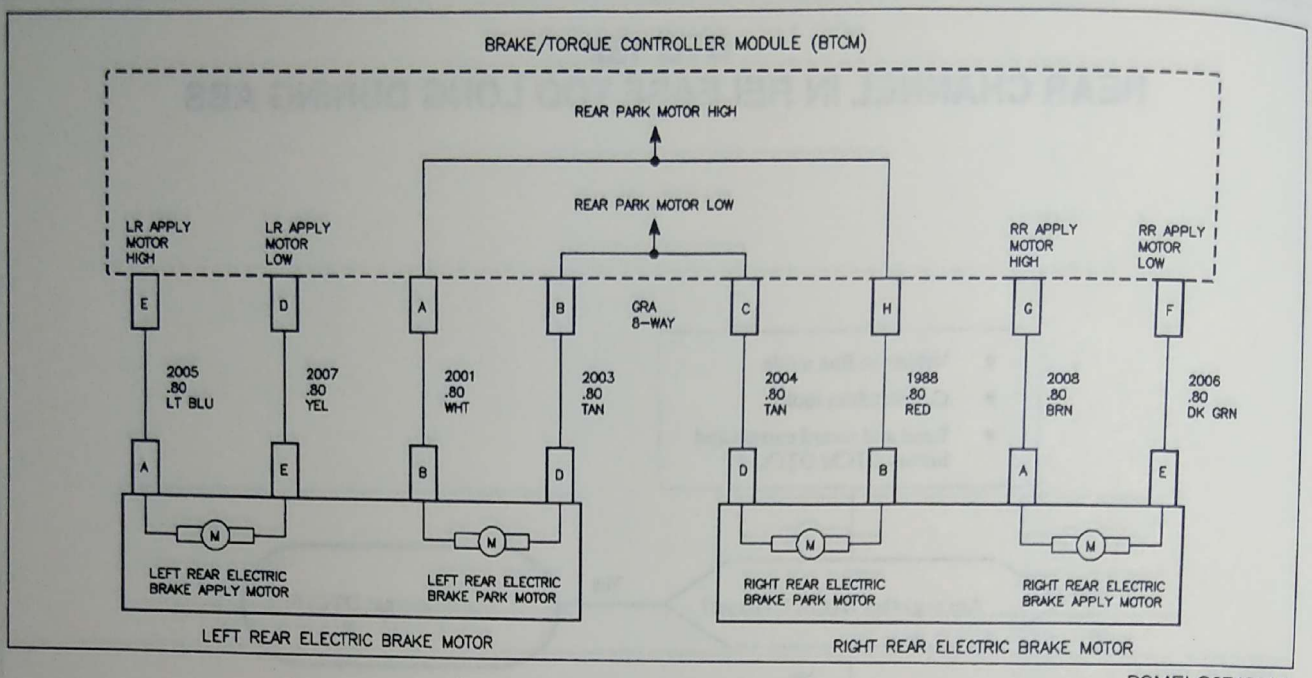
DTC 153 – LEFT REAR MOTOR CIRCUIT OPEN IN THE ON STATE



PSMELC67480AA

LEFT REAR MOTOR CIRCUIT OPEN IN THE ON STATE

The brake torque control module (BTCM) constantly monitors the motor circuit current. This information flag is set if an open is detected in the motor circuit while the motor is commanded On.

DTC PARAMETERS

DTC 153 will set if:

- Open circuit between the BTCM and left rear motor.
- Open or high resistance motor armature winding.
- Motor shunt losing contact with the armature.
- Left rear motor assembly failure.
- Malfunctioning motor driver circuit in the BTCM.

DTC 153 will set when:

Anytime the BTCM commands the rear enable relay On and a non-ABS stop is taking place. The fault exists if the left rear motor is being commanded a duty cycle greater than 50% and a current more than 1.6 amps and the feedback current from the left rear motor sense resistor is less than 1.0 amps.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

BTCM 156

TELLTALE ILLUMINATED

None

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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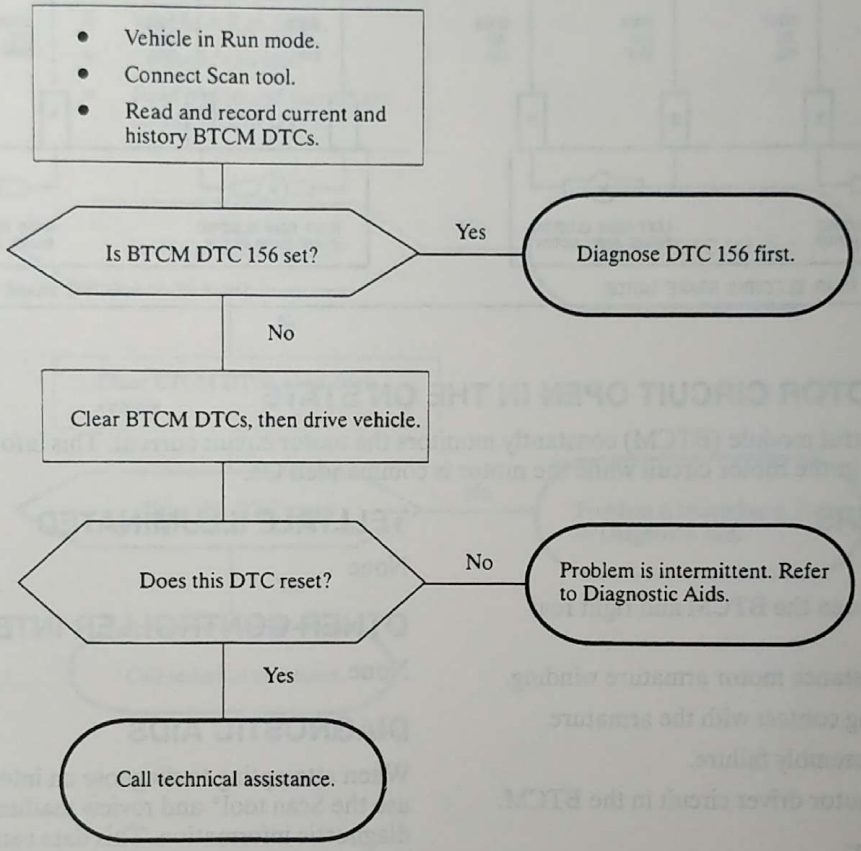
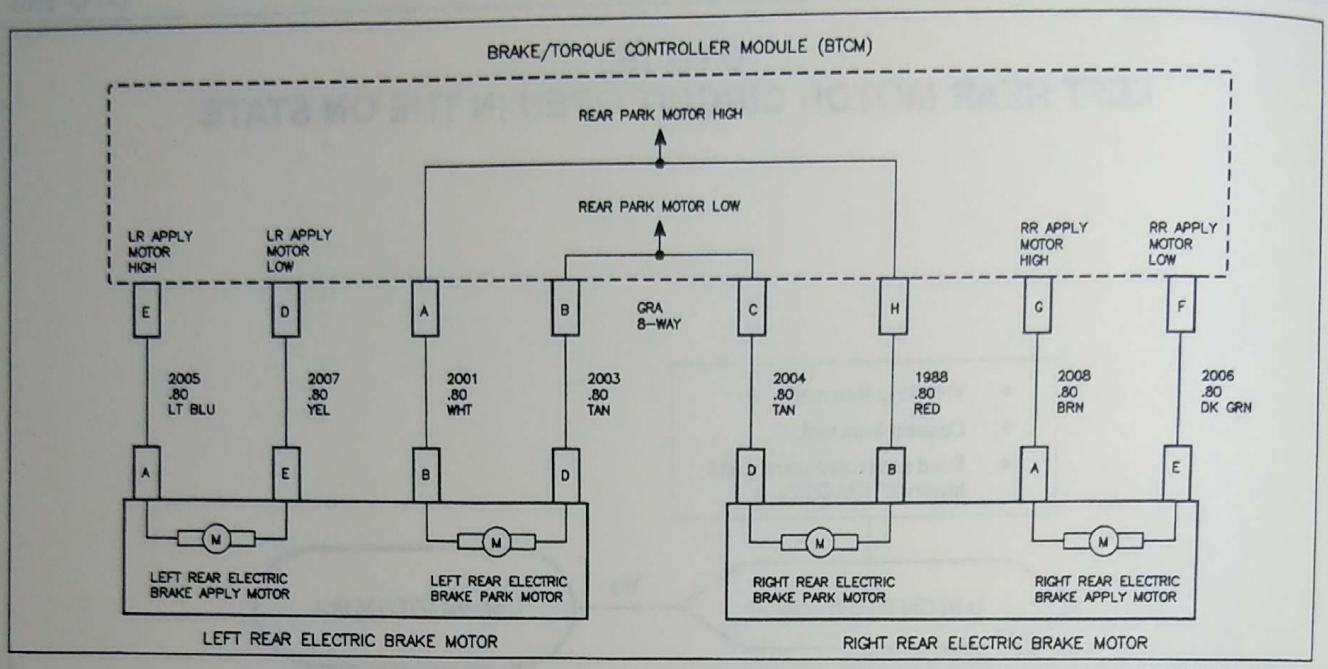
DTC 153
LEFT REAR MOTOR CIRCUIT OPEN IN THE ON STATE



DTC 154 – RIGHT REAR MOTOR CIRCUIT OPEN IN THE ON STATE



PSMELC67480AA

RIGHT REAR MOTOR CIRCUIT OPEN IN THE ON STATE

The brake torque control module (BTCM) constantly monitors the motor circuit current. This information flag is set if an open is detected in the motor circuit while the motor is commanded On.

DTC PARAMETERS

DTC 154 will set if:

- Open circuit between the BTCM and right rear motor.
- Open or high resistance motor armature winding.
- Motor shunt losing contact with the armature.
- Left rear motor assembly failure.
- Malfunctioning motor driver circuit in the BTCM.

DTC 154 will set when:

Anytime the BTCM commands the rear enable relay On and a non-ABS stop is taking place. The fault exists if the right rear motor is being commanded a duty cycle greater than 50% and a current more than 1.6 amps and the feedback current from the left rear motor sense resistor is less than 1.0 amps.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally.

RELATED DTCS

BTCM 161

TELLTALE ILLUMINATED

None

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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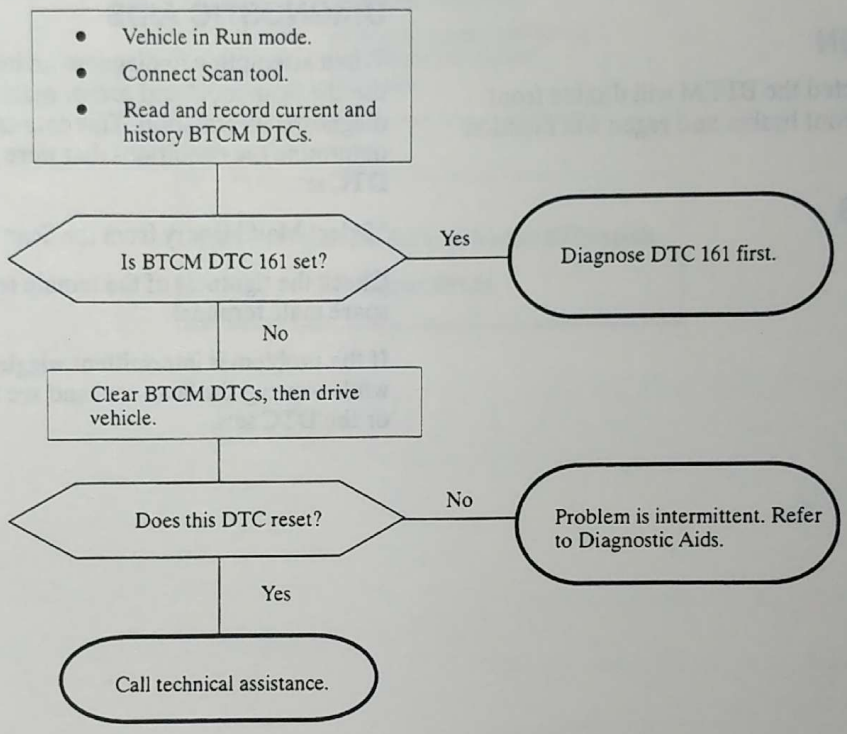
DTC 154
RIGHT REAR MOTOR CIRCUIT OPEN IN THE ON STATE



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DTC 155 – REAR MOTOR DRIVER FAULT

If the brake torque control module (BTCM) detects a fault with the rear motor driver chip it will disable front and rear ABS and rear brake apply.

DTC PARAMETERS

DTC 155 will set if:

The rear motor driver chip has failed.

DTC 155 will set when:

Anytime the BTCM commands the rear enable relay On.

FAILURE ACTION

If this failure is detected the BTCM will disable front and rear ABS. The front brakes and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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DTC 155
REAR MOTOR DRIVER FAULT

- Vehicle in Run mode.
- Connect Scan tool.
- Read and record current and history BTCM DTCs.
- Read and record Malf history data for possible future reference.

If DTC 155 is set it is due to an internal BTCM fault.

Replace BTCM.

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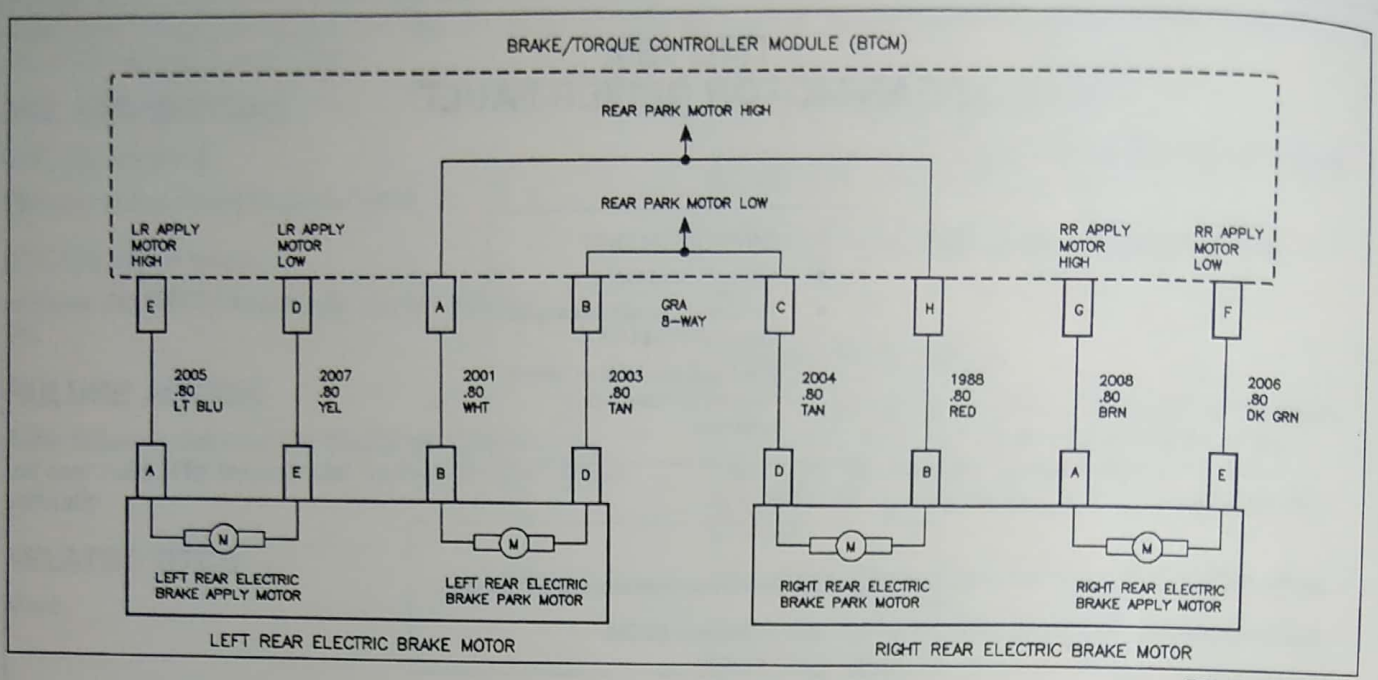
DTC 156 – LEFT REAR MOTOR CIRCUIT OPEN



PSMELC67480AA

LEFT REAR MOTOR CIRCUIT OPEN

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If an open condition is detected this DTC will be set and the failed rear brake operation will be suspended.

DTC PARAMETERS

DTC 156 will set if:

- Open circuit between the BTCM and left rear motor.
- Open or high resistance motor armature winding.
- Left rear motor assembly failure.
- Malfunctioning motor driver circuit in the BTCM.

DTC 156 will set when:

Anytime the BTCM commands the rear enable relay On and the left rear motor is inactive (Off). The fault exists if the voltage at left rear motor high is greater than 4.3 volts and the voltage at left rear motor low is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and left rear brake apply. The front brakes, the right rear brake system and regen will function normally.

RELATED DTCS

BTCM 153

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

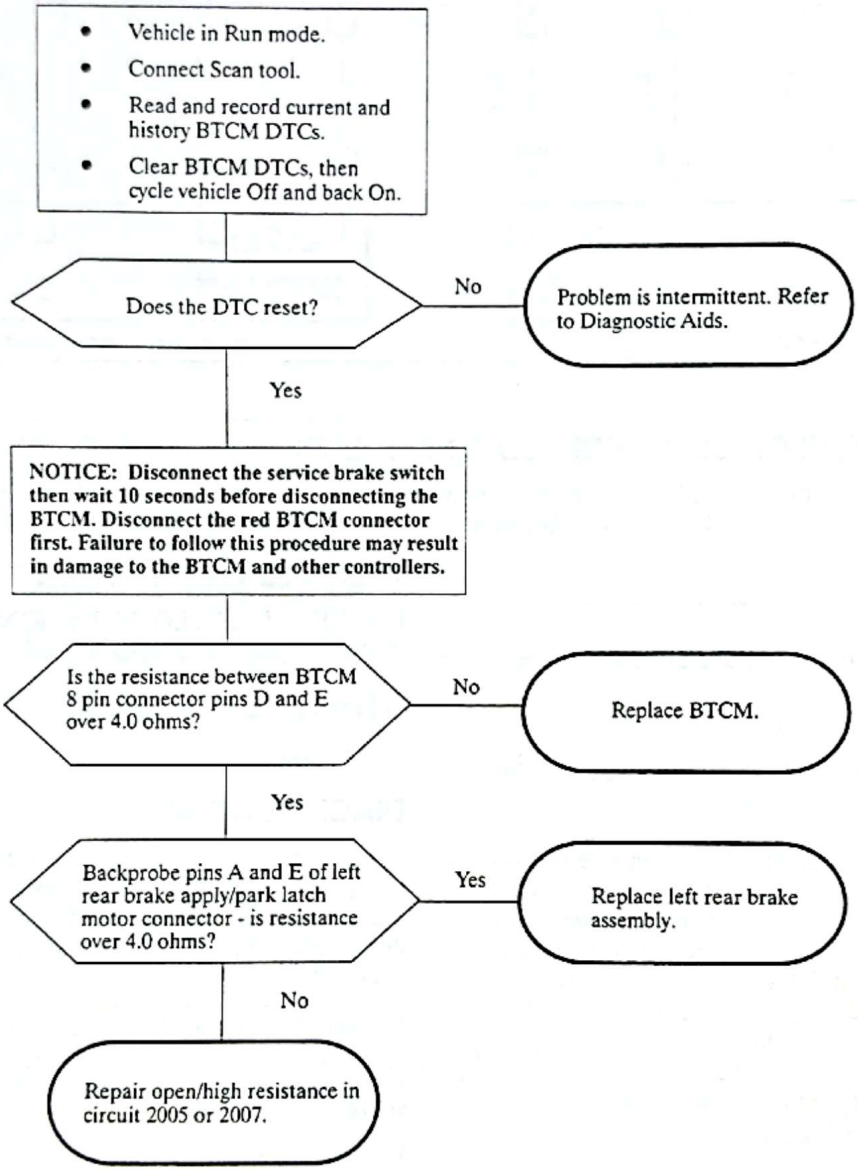
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 156
LEFT REAR MOTOR CIRCUIT OPEN


• Vehicle in Run mode.
• Connect Scan tool.
• Read and record current and history BTCM DTCs.
• Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is the resistance between BTCM 8 pin connector pins D and E over 4.0 ohms?
No
Replace BTCM.
Yes
Backprobe pins A and E of left rear brake apply/park latch motor connector - is resistance over 4.0 ohms?
Yes
Replace left rear brake assembly.
No
Repair open/high resistance in circuit 2005 or 2007.

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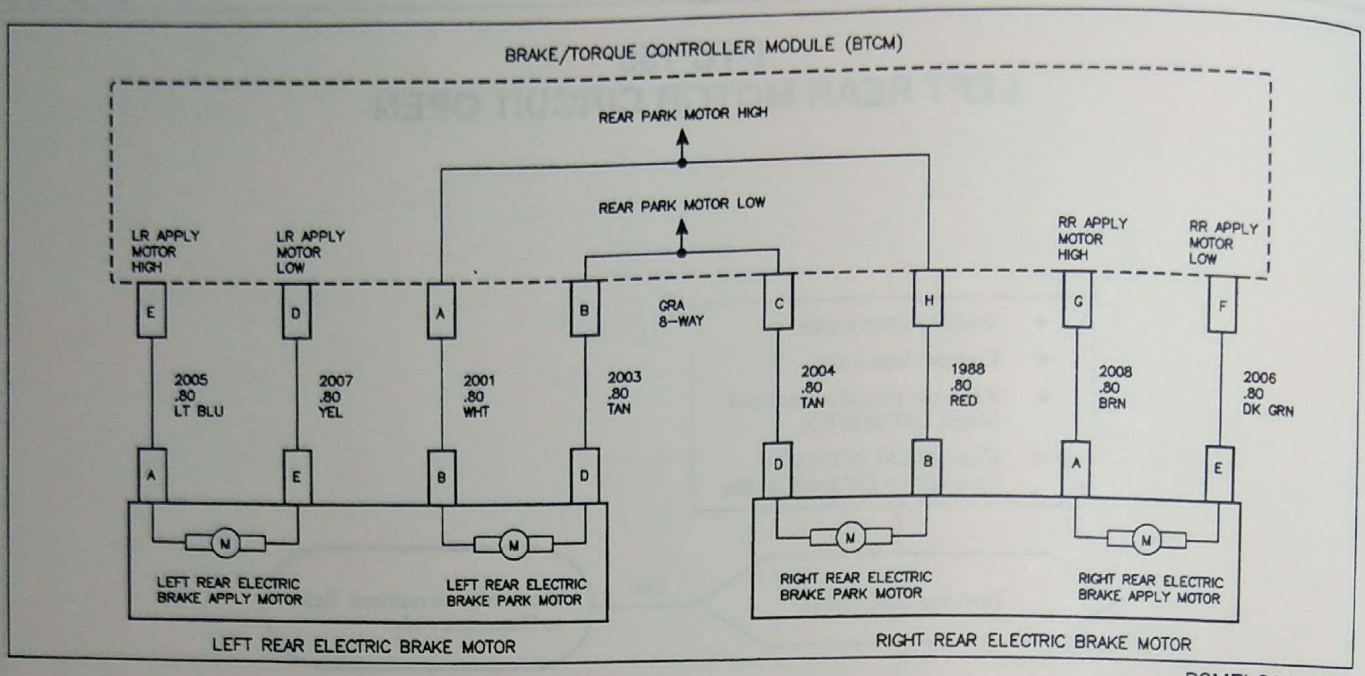
DTC 157 – LEFT REAR MOTOR CIRCUIT SHORTED TO GROUND



PSMELC67480AA

LEFT REAR MOTOR CIRCUIT SHORTED TO GROUND

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If a short to ground is detected this DTC will be set and the failed rear brake operation will be suspended.

DTC PARAMETERS

DTC 157 will set if:

- Grounded circuit between the BTCM and left rear motor.
- Motor armature winding grounded.
- Malfunctioning motor driver circuit in the BTCM.

DTC 157 will set when:

Anytime the BTCM commands the rear enable relay On and the left rear motor is inactive (Off) if the voltage at left rear motor high is less than 4.3 volts and the voltage at left rear motor low is less than 1.7 volts. This DTC will also set if the left rear motor is active (On) and the voltage drop (from switched battery) is greater than 4.5 volts at left rear motor high when active in the forward direction or the voltage drop is greater than 4.5 volts at left rear motor low when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and left rear brake apply. The front brakes, the right rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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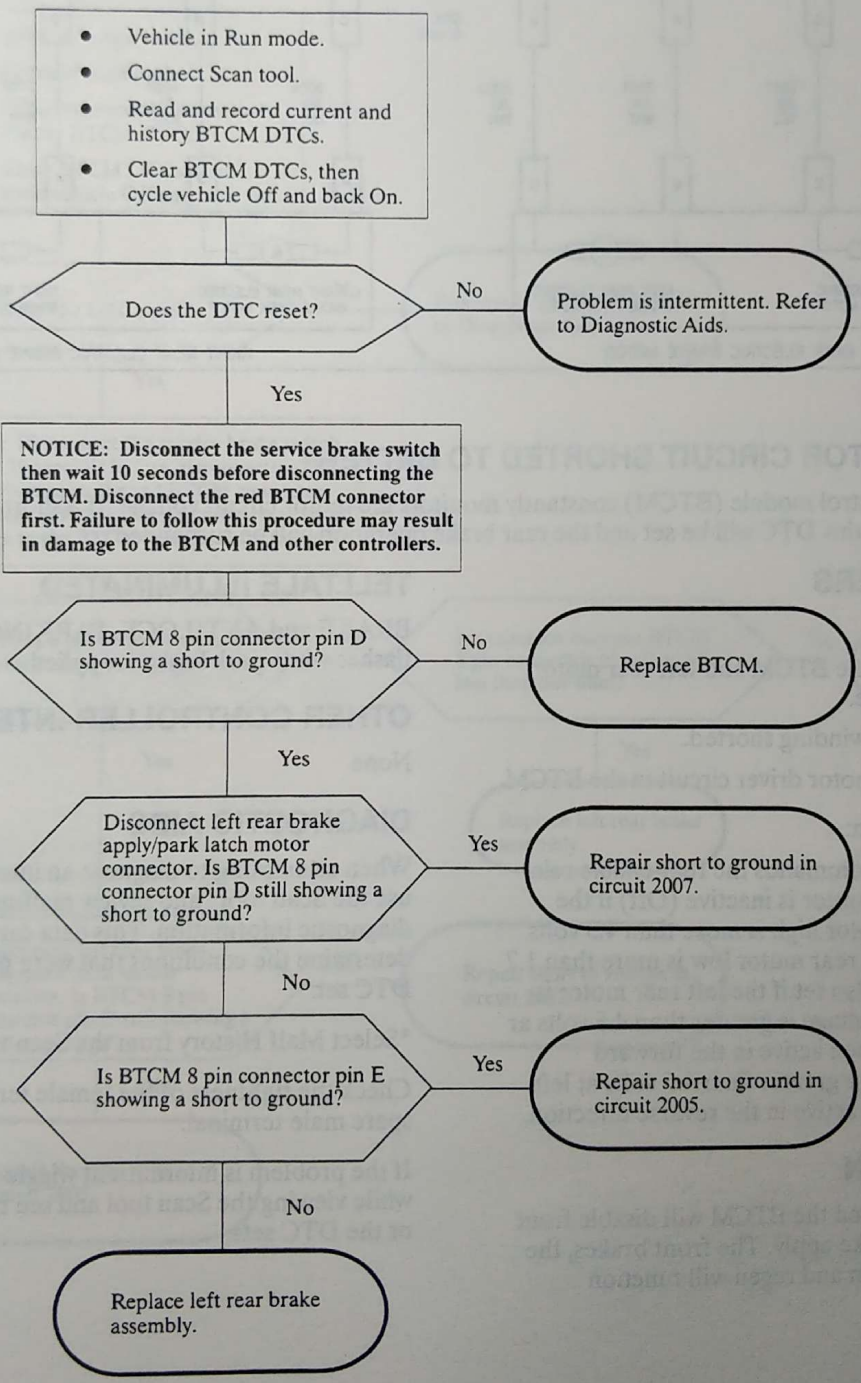
DTC 157
LEFT REAR MOTOR CIRCUIT SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is BTCM 8 pin connector pin D showing a short to ground?
No
Replace BTCM.
Yes
Disconnect left rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin D still showing a short to ground?
Yes
Repair short to ground in circuit 2007.
No
Is BTCM 8 pin connector pin E showing a short to ground?
Yes
Repair short to ground in circuit 2005.
No
Replace left rear brake assembly.

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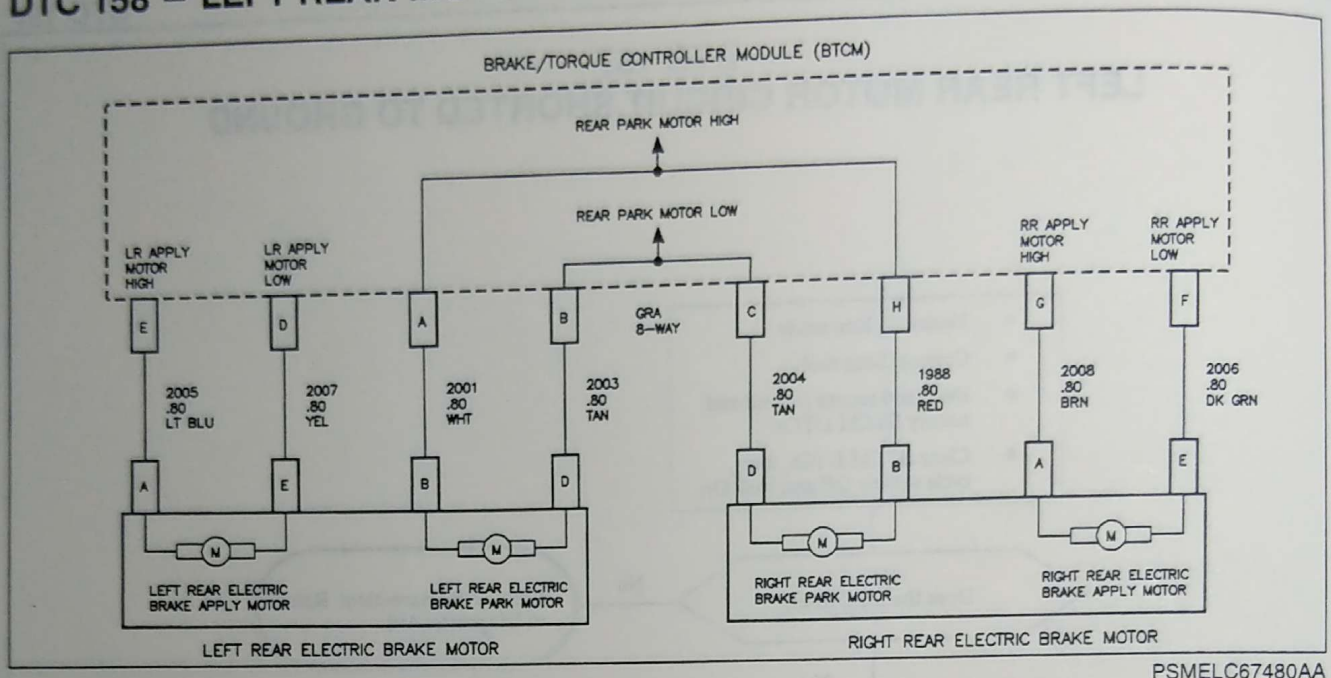
DTC 158 – LEFT REAR MOTOR CIRCUIT SHORTED TO BATTERY



PSMELC67480AA

LEFT REAR MOTOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If a short to battery condition is detected this DTC will be set and the rear brake operation will be suspended.

DTC PARAMETERS

DTC 158 will set if:

- Circuit between the BTCM and left rear motor shorted to voltage.
- Motor armature winding shorted.
- Malfunctioning motor driver circuit in the BTCM.

DTC 158 will set when:

Anytime the BTCM commands the rear enable relay On, and the left rear motor is inactive (Off) if the voltage at left rear motor high is more than 4.3 volts and the voltage at left rear motor low is more than 1.7 volts. This DTC will also set if the left rear motor is active (On) and the voltage is greater than 4.5 volts ar left rear motor low when active in the forward direction or the voltage greater than 4.5 volts at left rear motor high when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will disable front ABS and left rear brake apply. The front brakes, the right rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

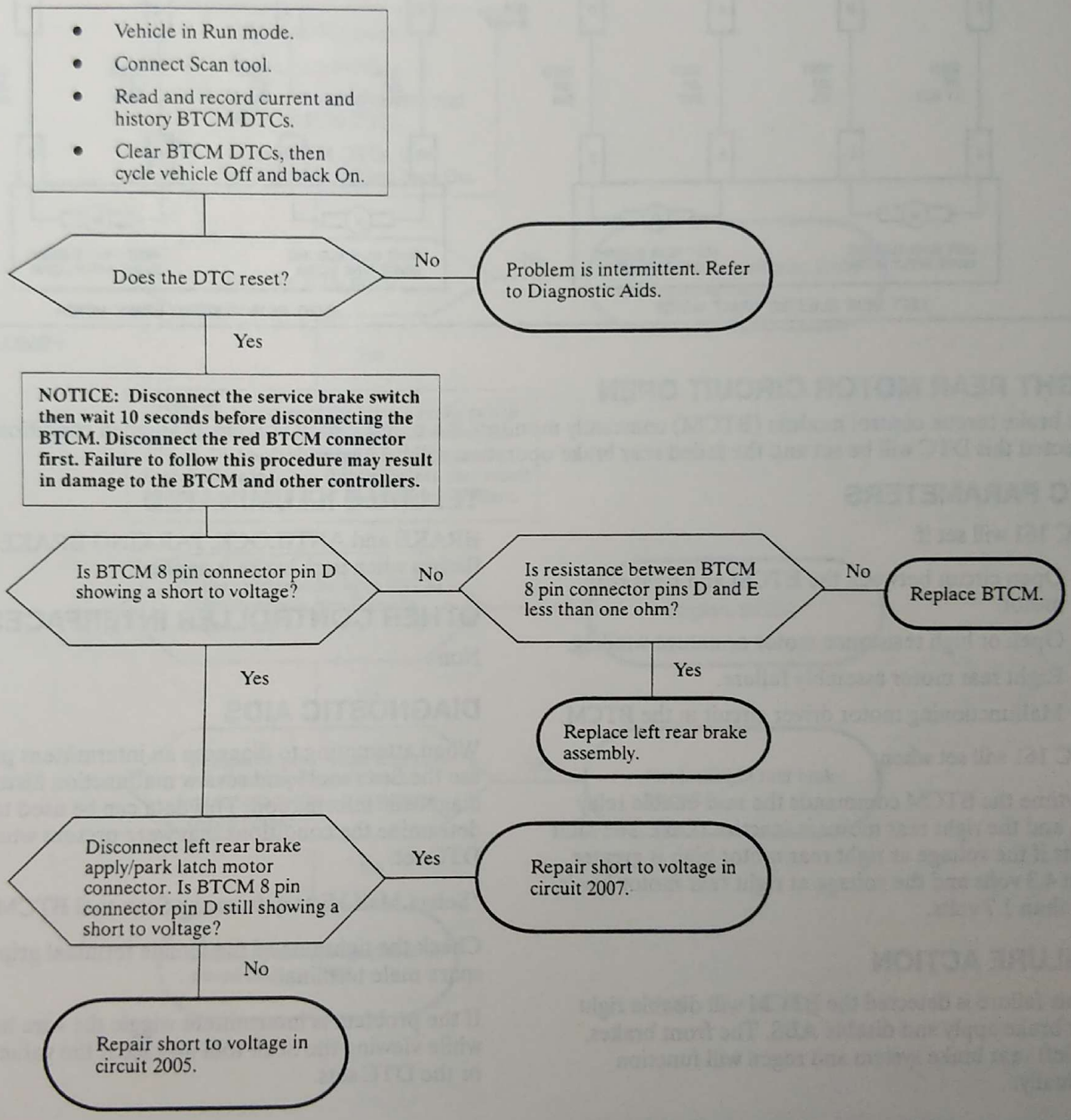
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

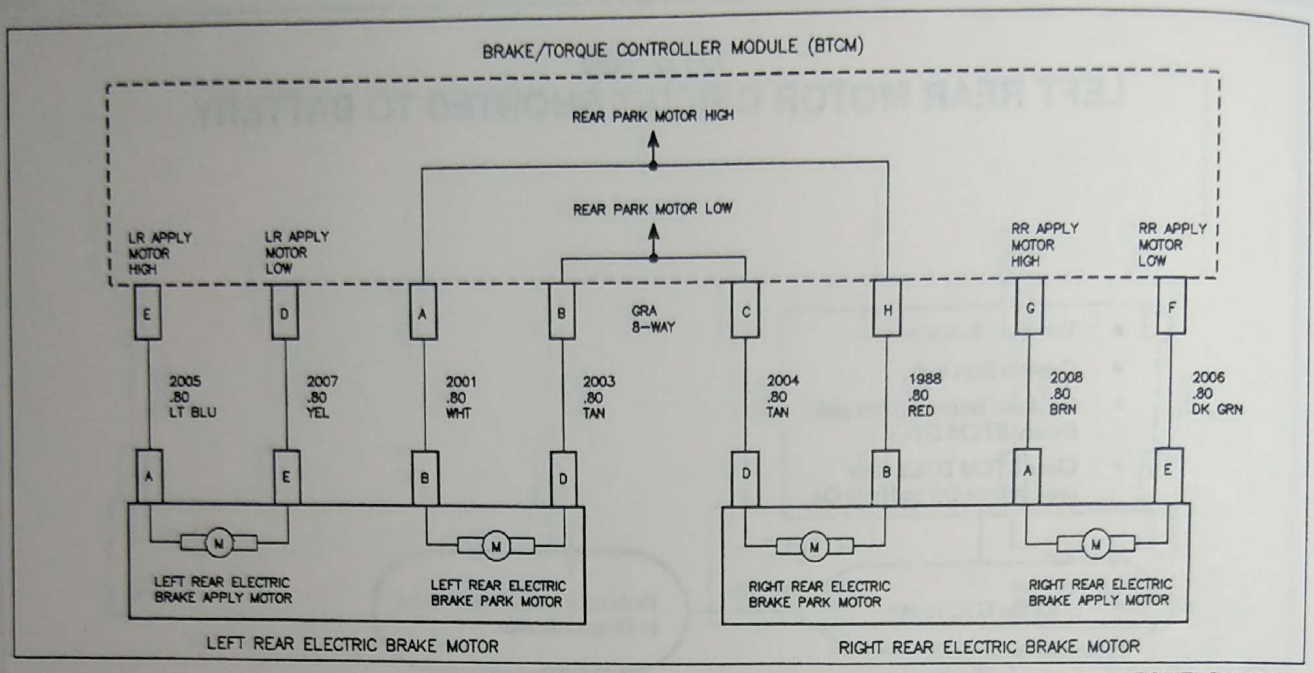
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 158
LEFT REAR MOTOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is BTCM 8 pin connector pin D showing a short to voltage?
No
Is resistance between BTCM 8 pin connector pins D and E less than one ohm?
No
Replace BTCM.
Yes
Yes
Replace left rear brake assembly.
Disconnect left rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin D still showing a short to voltage?
Yes
Repair short to voltage in circuit 2007.
No
Repair short to voltage in circuit 2005.

DTC 161 – RIGHT REAR MOTOR CIRCUIT OPEN



PSMELC67480AA

RIGHT REAR MOTOR CIRCUIT OPEN

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If an open condition is detected this DTC will be set and the failed rear brake operation will be suspended.

DTC PARAMETERS

DTC 161 will set if:

- Open circuit between the BTCM and right rear motor.
- Open or high resistance motor armature winding.
- Right rear motor assembly failure.
- Malfunctioning motor driver circuit in the BTCM.

DTC 161 will set when:

Anytime the BTCM commands the rear enable relay On, and the right rear motor is inactive (Off). The fault exists if the voltage ar right rear motor high is greater than 4.3 volts and the voltage at right rear motor low is less than 1.7 volts.

FAILURE ACTION

If this failure is detected the BTCM will disable right rear brake apply and disable ABS. The front brakes, the left rear brake system and regen will function normally.

RELATED DTCS

BTCM 154

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

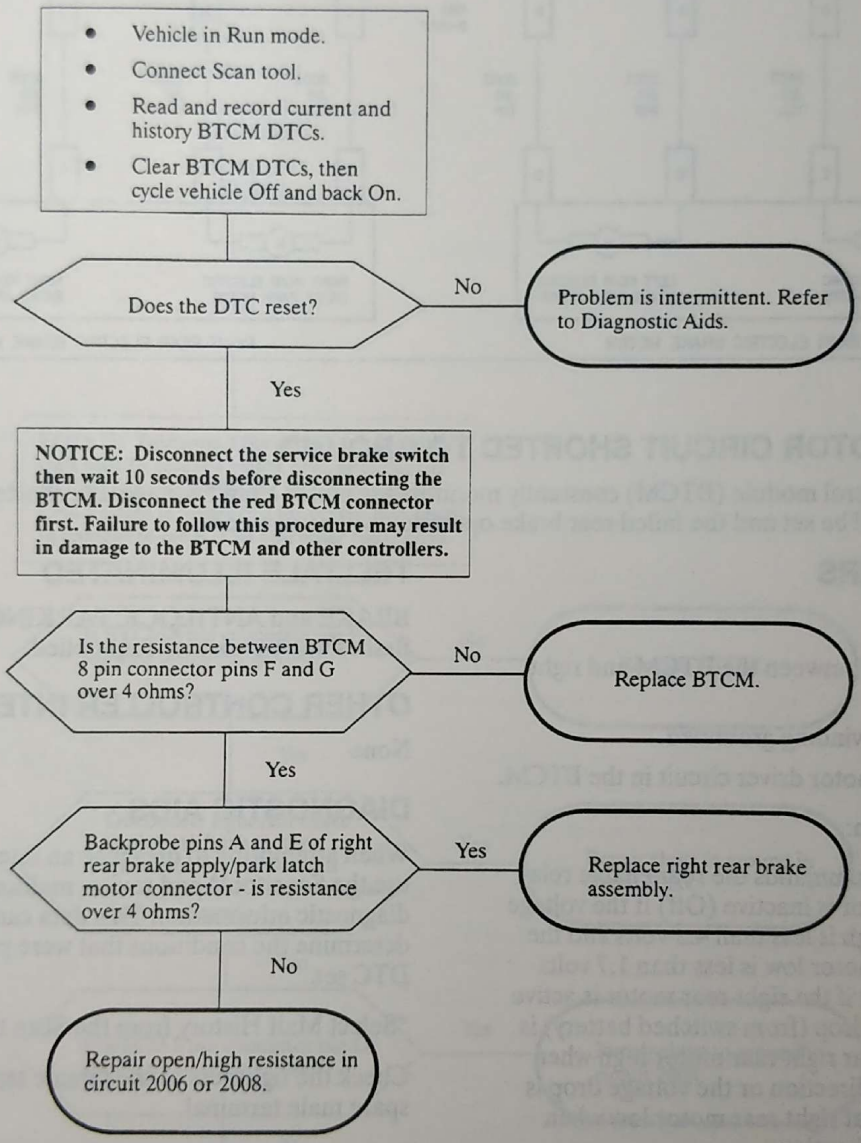
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 161
RIGHT REAR MOTOR CIRCUIT OPEN


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is the resistance between BTCM 8 pin connector pins F and G over 4 ohms?
No
Replace BTCM.
Yes
Backprobe pins A and E of right rear brake apply/park latch motor connector - is resistance over 4 ohms?
Yes
Replace right rear brake assembly.
No
Repair open/high resistance in circuit 2006 or 2008.

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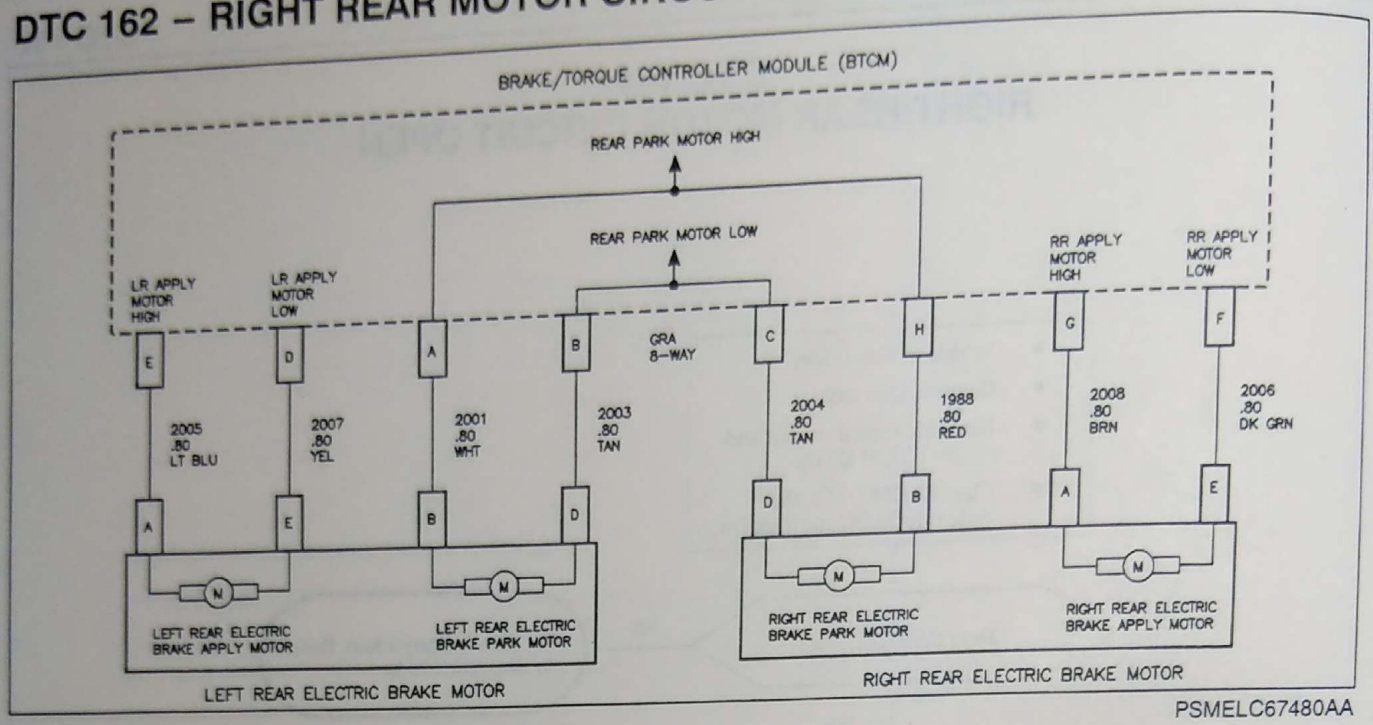
DTC 162 – RIGHT REAR MOTOR CIRCUIT SHORTED TO GROUND



PSMELC67480AA

RIGHT REAR MOTOR CIRCUIT SHORTED TO GROUND

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If a shorted condition is detected this DTC will be set and the failed rear brake operation will be suspended.

DTC PARAMETERS

DTC 162 will set if:

- Grounded circuit between the BTCM and right rear motor.
- Motor armature winding grounded.
- Malfunctioning motor driver circuit in the BTCM.

DTC 162 will set when:

Anytime the BTCM commands the rear enable relay On the right rear motor is inactive (Off) if the voltage at right rear motor high is less than 4.3 volts and the voltage at right rear motor low is less than 1.7 volts. This DTC will also set if the right rear motor is active (On) and the voltage drop (from switched battery) is greater than 4.5 volts ar right rear motor high when active in the forward direction or the voltage drop is greater than 4.5 volts at right rear motor low when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will disable right rear brake apply and disable ABS. The front brakes, the left rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and ANTILOCK. PARKING BRAKE *telltale* flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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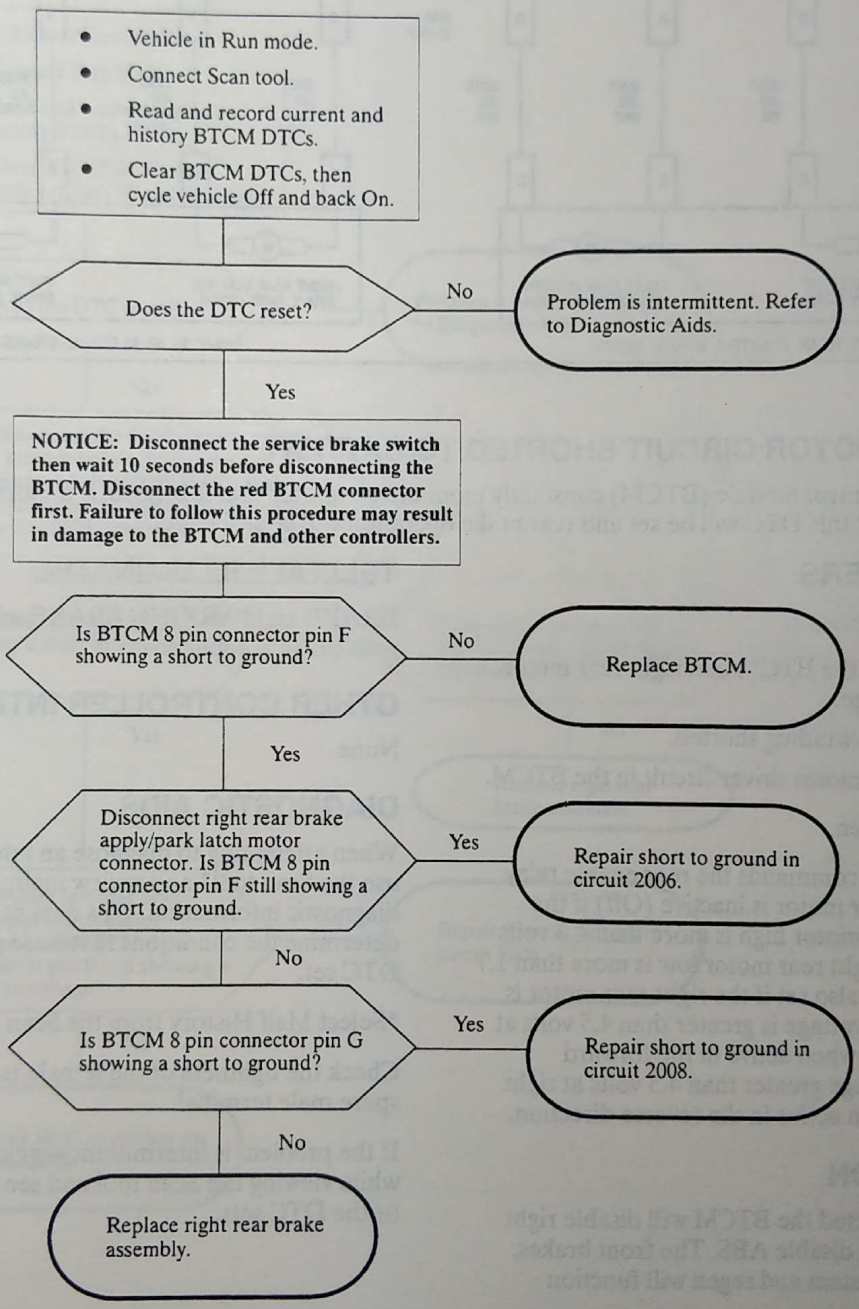
DTC 162
RIGHT REAR MOTOR CIRCUIT SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is BTCM 8 pin connector pin F showing a short to ground?
No
Replace BTCM.
Yes
Disconnect right rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin F still showing a short to ground.
Yes
Repair short to ground in circuit 2006.
No
Is BTCM 8 pin connector pin G showing a short to ground?
Yes
Repair short to ground in circuit 2008.
No
Replace right rear brake assembly.

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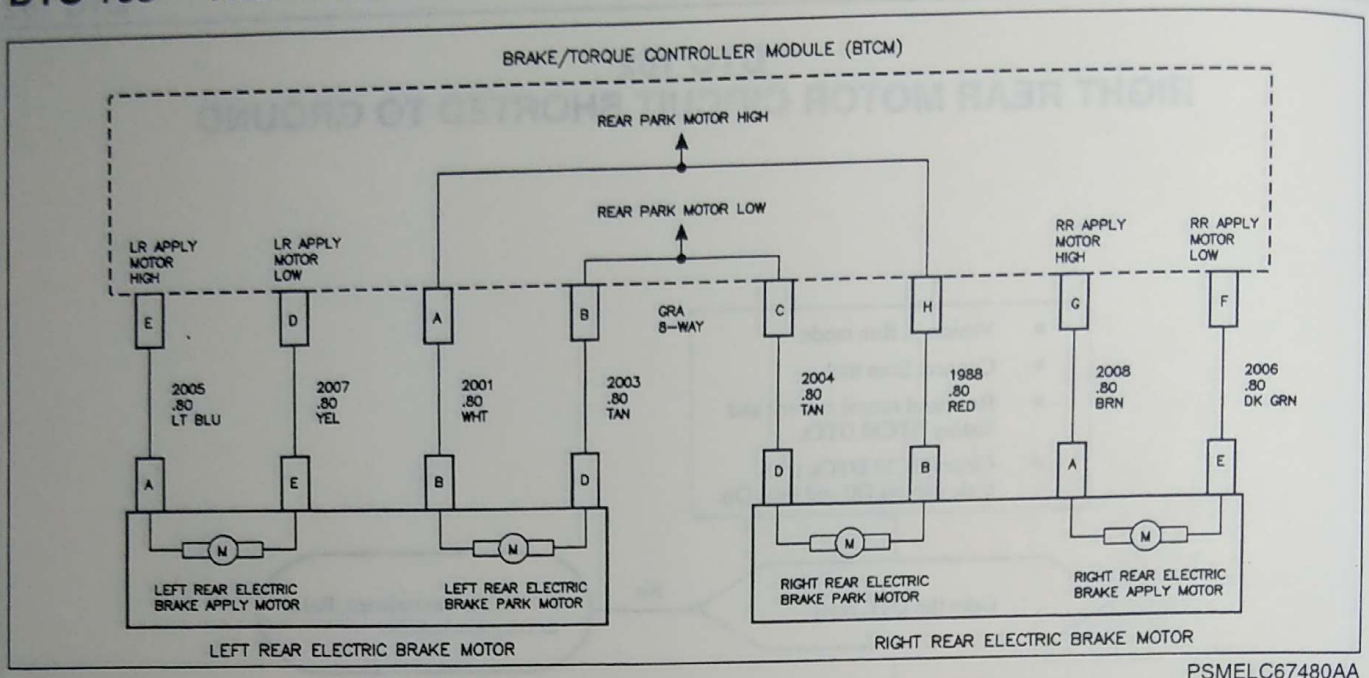
DTC 163 – RIGHT REAR MOTOR CIRCUIT SHORTED TO BATTERY


BRAKE/TORQUE CONTROLLER MODULE (BTCM)
REAR PARK MOTOR HIGH
REAR PARK MOTOR LOW
LR APPLY MOTOR HIGH
LR APPLY MOTOR LOW
RR APPLY MOTOR HIGH
RR APPLY MOTOR LOW
GRA 8-WAY
2005 .80 LT BLU
2007 .80 YEL
2001 .80 WHT
2003 .80 TAN
2004 .80 TAN
1988 .80 RED
2008 .80 BRN
2006 .80 DK GRN
LEFT REAR ELECTRIC BRAKE APPLY MOTOR
LEFT REAR ELECTRIC BRAKE PARK MOTOR
RIGHT REAR ELECTRIC BRAKE PARK MOTOR
RIGHT REAR ELECTRIC BRAKE APPLY MOTOR
LEFT REAR ELECTRIC BRAKE MOTOR
RIGHT REAR ELECTRIC BRAKE MOTOR

PSMELC67480AA

RIGHT REAR MOTOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If a short to battery condition is detected this DTC will be set and rear brake operation will be suspended.

DTC PARAMETERS

DTC 163 will set if:

- Circuit between the BTCM and right rear motor shorted to voltage.
- Motor armature winding shorted.
- Malfunctioning motor driver circuit in the BTCM.

DTC 163 will set when:

Anytime the BTCM commands the rear enable relay On and the right rear motor is inactive (Off) if the voltage at right rear motor high is more than 4.3 volts and the voltage at right rear motor low is more than 1.7 volts. This DTC will also set if the right rear motor is active (On) and the voltage is greater than 4.5 volts at right rear motor low when active in the forward direction or the voltage greater than 4.5 volts at right rear motor high when active in the reverse direction.

FAILURE ACTION

If this failure is detected the BTCM will disable right rear brake apply and disable ABS. The front brakes, the left rear brake system and regen will function normally.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

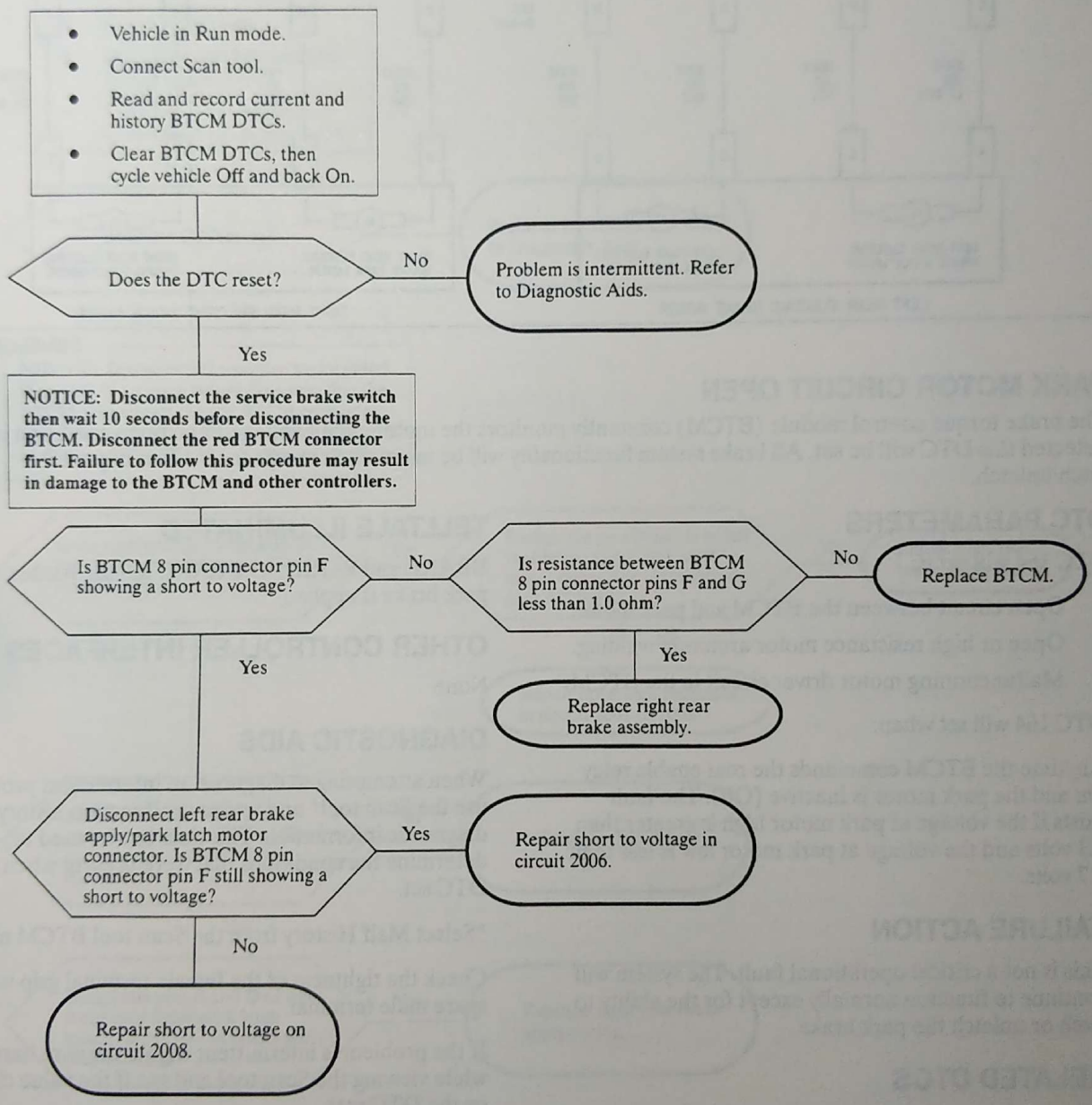
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

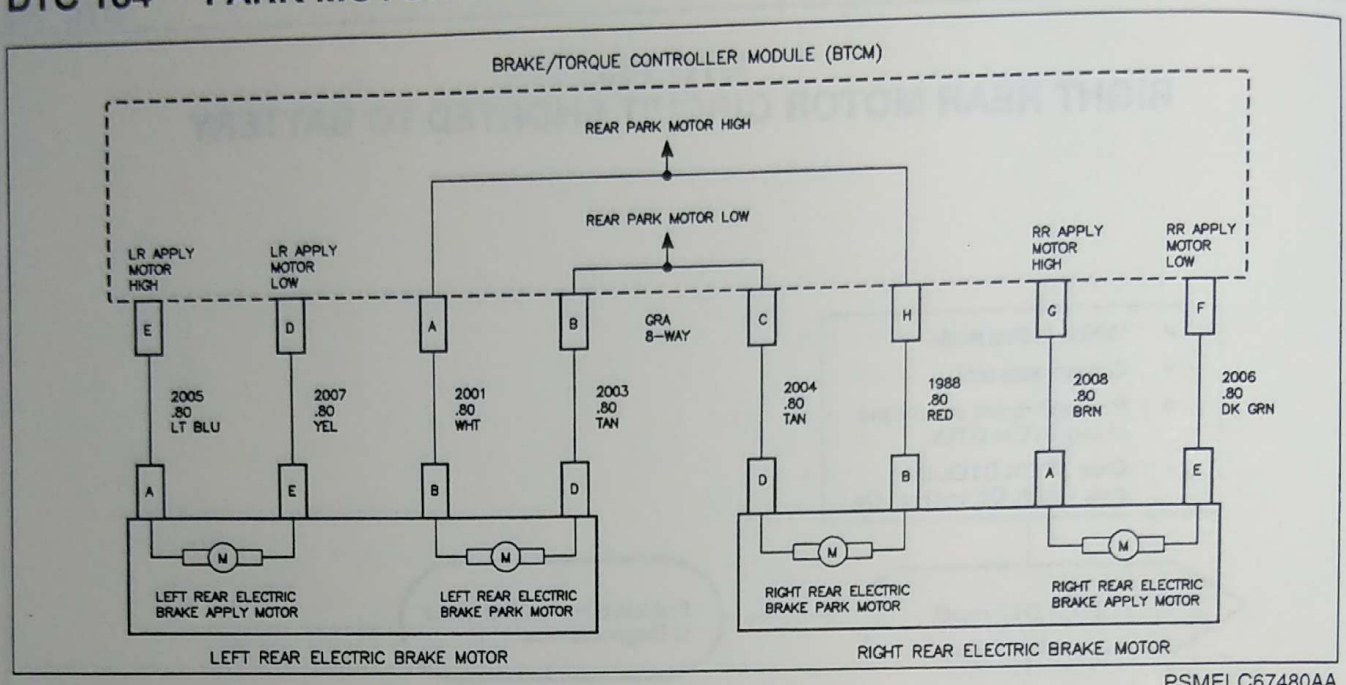
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 163
RIGHT REAR MOTOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is BTCM 8 pin connector pin F showing a short to voltage?
No
Is resistance between BTCM 8 pin connector pins F and G less than 1.0 ohm?
No
Replace BTCM.
Yes
Replace right rear brake assembly.
Yes
Disconnect left rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin F still showing a short to voltage?
Yes
Repair short to voltage in circuit 2006.
No
Repair short to voltage on circuit 2008.

DTC 164 – PARK MOTOR CIRCUIT OPEN



PSMELC67480AA

PARK MOTOR CIRCUIT OPEN

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If an open condition is detected this DTC will be set. All brake system functionality will be maintained except for the loss of park latch/unlatch.

DTC PARAMETERS

DTC 164 will set if:

- Open circuit between the BTCM and park motor.
- Open or high resistance motor armature winding.
- Malfunctioning motor driver circuit in the BTCM.

DTC 164 will set when:

Anytime the BTCM commands the rear enable relay On and the park motor is inactive (Off). The fault exists if the voltage at park motor high is greater than 4.3 volts and the voltage at park motor low is less than 1.7 volts.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally except for the ability to latch or unlatch the park brake.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

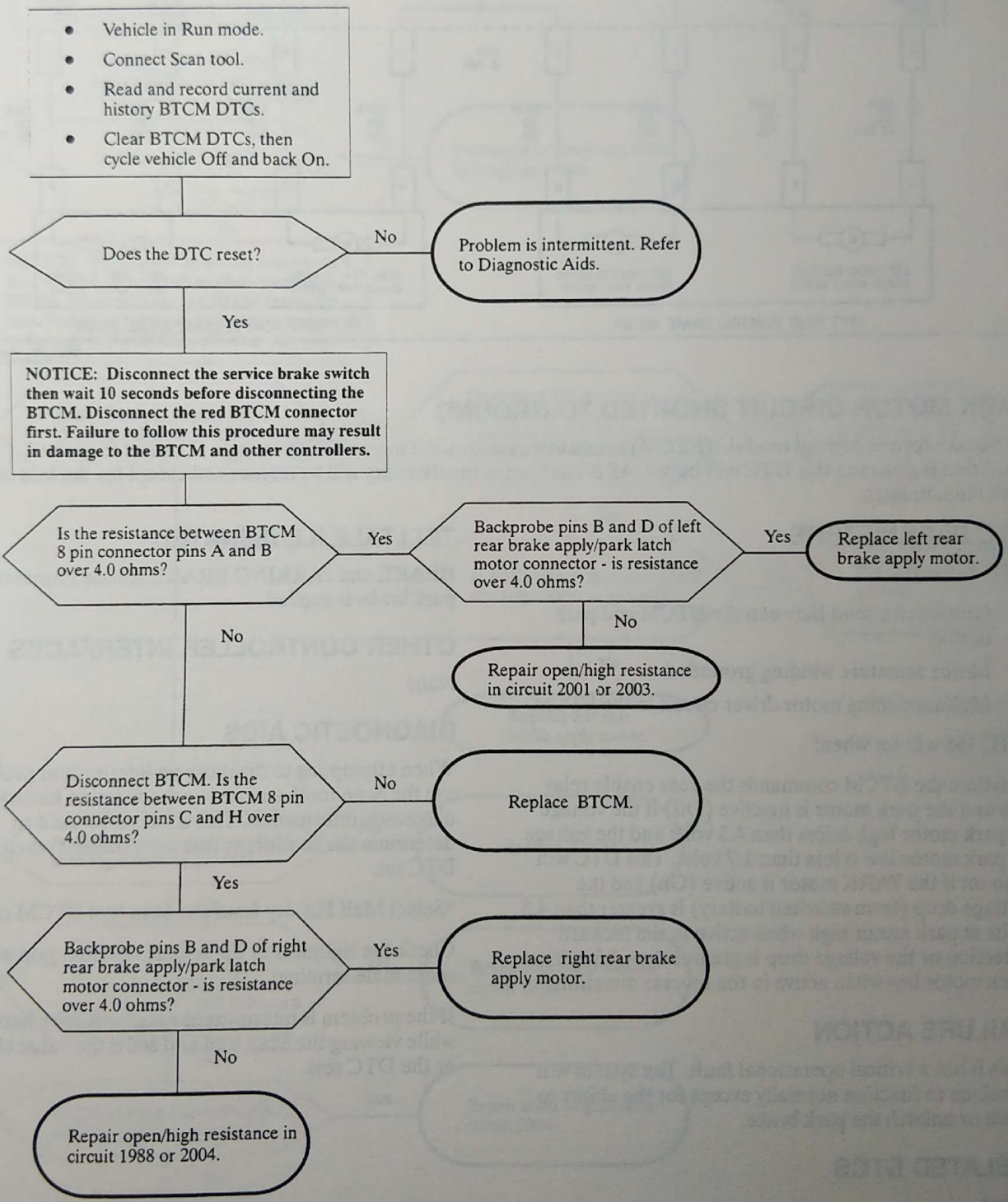
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 164
PARK MOTOR CIRCUIT OPEN


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is the resistance between BTCM 8 pin connector pins A and B over 4.0 ohms?
Yes
Backprobe pins B and D of left rear brake apply/park latch motor connector - is resistance over 4.0 ohms?
Yes
Replace left rear brake apply motor.
No
Repair open/high resistance in circuit 2001 or 2003.
No
Disconnect BTCM. Is the resistance between BTCM 8 pin connector pins C and H over 4.0 ohms?
No
Replace BTCM.
Yes
Backprobe pins B and D of right rear brake apply/park latch motor connector - is resistance over 4.0 ohms?
Yes
Replace right rear brake apply motor.
No
Repair open/high resistance in circuit 1988 or 2004.

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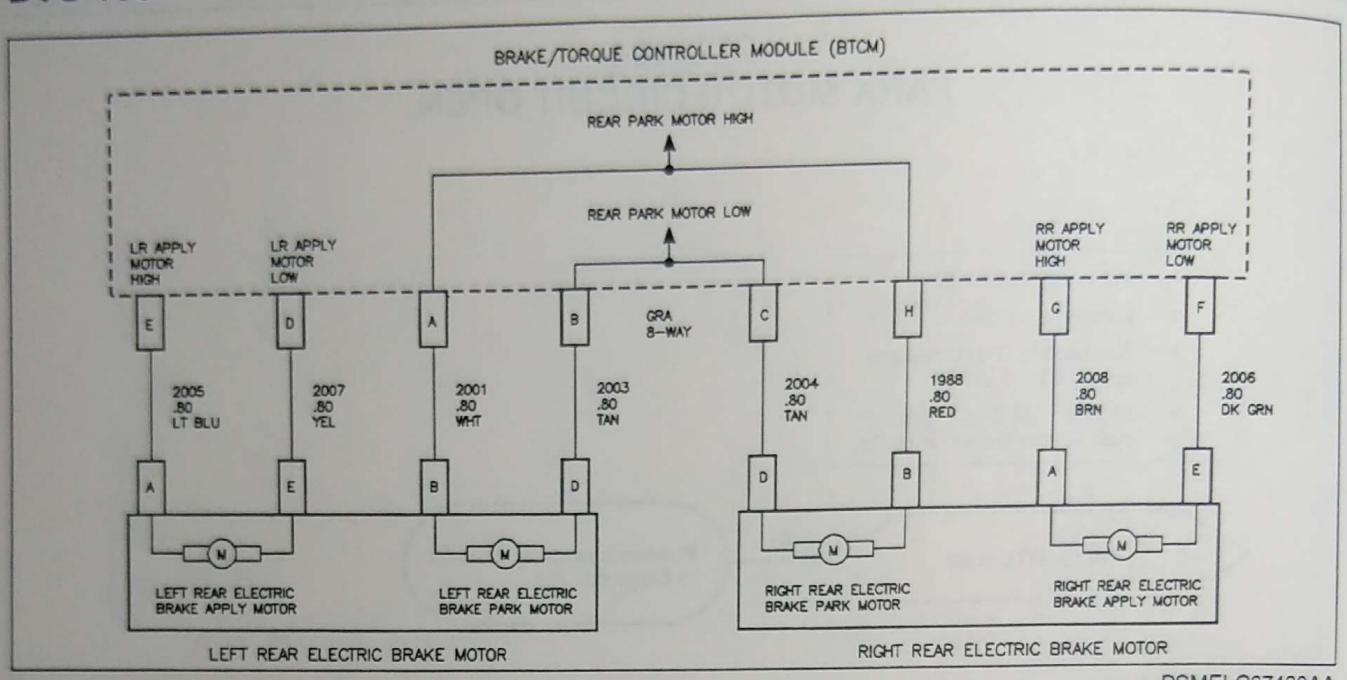
DTC 165 – PARK MOTOR CIRCUIT SHORTED TO GROUND



PSMELC67480AA

PARK MOTOR CIRCUIT SHORTED TO GROUND

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If a short to ground condition is detected this DTC will be set. All brake system functionality will be maintained except for the loss of park latch/unlatch.

DTC PARAMETERS

DTC 165 will set if:

- Grounded circuit between the BTCM and park motor.
- Motor armature winding grounded.
- Malfunctioning motor driver circuit in the BTCM.

DTC 165 will set when:

Anytime the BTCM commands the rear enable relay On and the park motor is inactive (Off) if the voltage at park motor high is less than 4.3 volts and the voltage at park motor low is less than 1.7 volts. This DTC will also set if the PARK motor is active (On) and the voltage drop (from switched battery) is greater than 4.5 volts at park motor high when active in the forward direction or the voltage drop is greater than 4.5 volts at park motor low when active in the reverse direction.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally except for the ability to latch or unlatch the park brake.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

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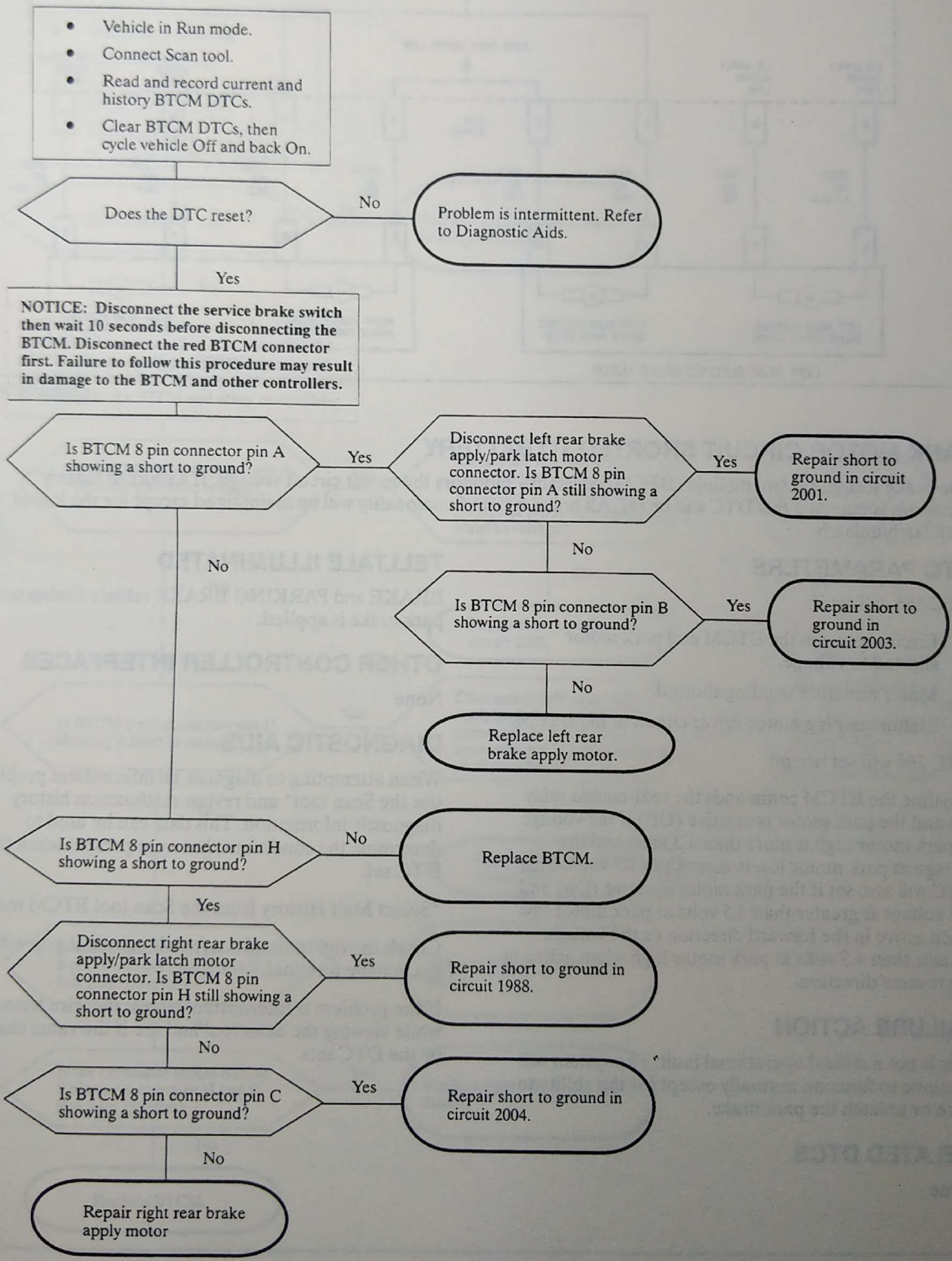
DTC 165
PARK MOTOR CIRCUIT SHORTED TO GROUND


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is BTCM 8 pin connector pin A showing a short to ground?
Yes
Disconnect left rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin A still showing a short to ground?
Yes
Repair short to ground in circuit 2001.
No
Is BTCM 8 pin connector pin B showing a short to ground?
Yes
Repair short to ground in circuit 2003.
No
Replace left rear brake apply motor.
No
Is BTCM 8 pin connector pin H showing a short to ground?
No
Replace BTCM.
Yes
Disconnect right rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin H still showing a short to ground?
Yes
Repair short to ground in circuit 1988.
No
Is BTCM 8 pin connector pin C showing a short to ground?
Yes
Repair short to ground in circuit 2004.
No
Repair right rear brake apply motor

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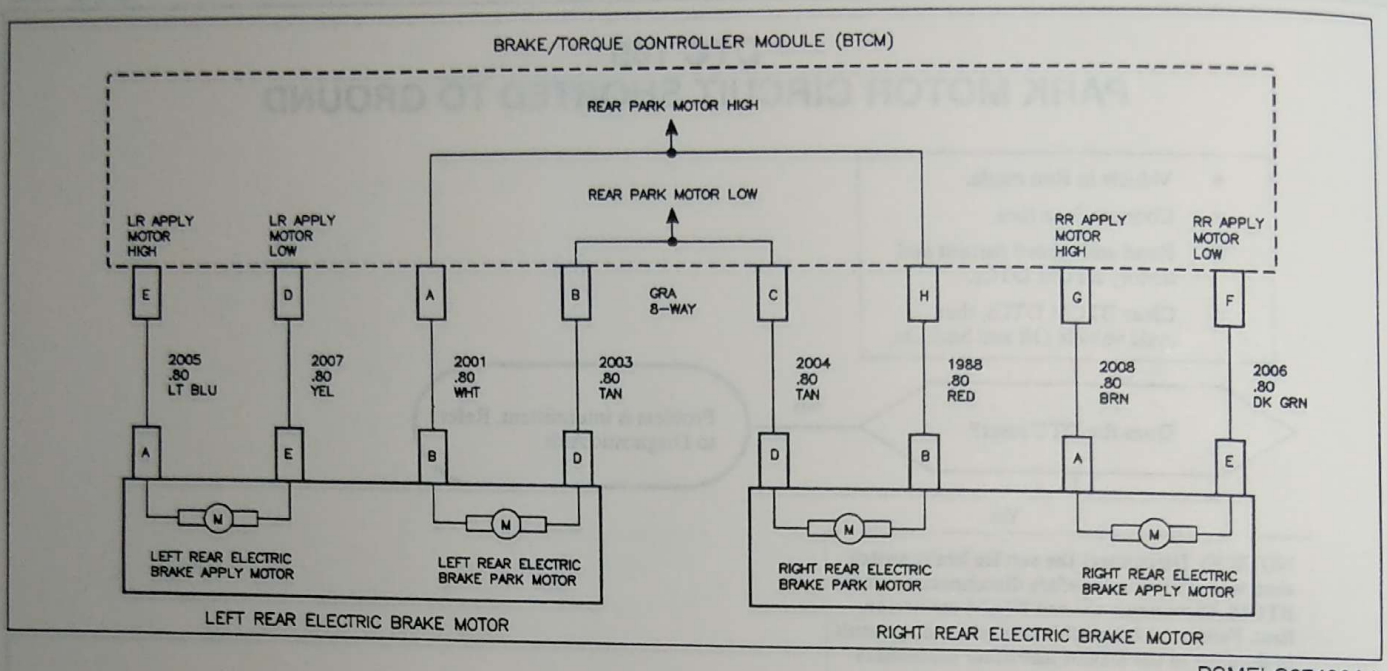
DTC 166 – PARK MOTOR CIRCUIT SHORTED TO BATTERY



PSMELC67480AA

PARK MOTOR CIRCUIT SHORTED TO BATTERY

The brake torque control module (BTCM) constantly monitors the motor circuit voltage. If a short to battery condition is detected this DTC will be set. All brake system functionality will be maintained except for the loss of park latch/unlatch.

DTC PARAMETERS

DTC 166 will set if:

- Circuit between the BTCM and park motor shorted to voltage.
- Motor armature winding shorted.
- Malfunctioning motor driver circuit in the BTCM.

DTC 166 will set when:

Anytime the BTCM commands the rear enable relay On and the park motor is inactive (Off) if the voltage at park motor high is more than 4.3 volts and the voltage at park motor low is more than 1.7 volts. This DTC will also set if the park motor is active (On) and the voltage is greater than 4.5 volts at park motor low when active in the forward direction or the voltage greater than 4.5 volts at park motor high when active in the reverse direction.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally except for the ability to latch or unlatch the park brake.

RELATED DTCS

None

TELLTALE ILLUMINATED

BRAKE and PARKING BRAKE telltale flashes when park brake is applied.

OTHER CONTROLLER INTERFACES

None

DIAGNOSTIC AIDS

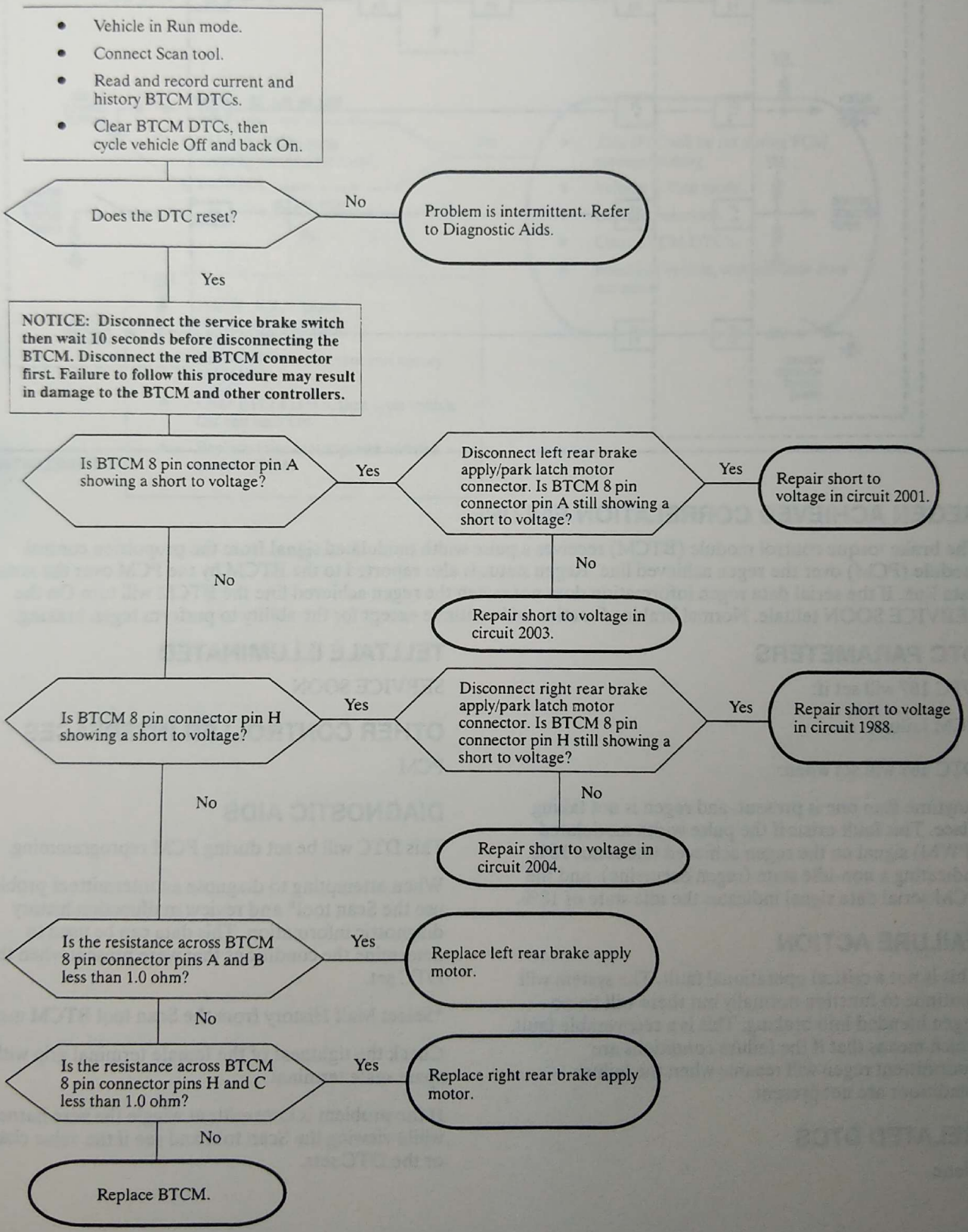
When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

*Select Malf History from the Scan tool BTCM menu.

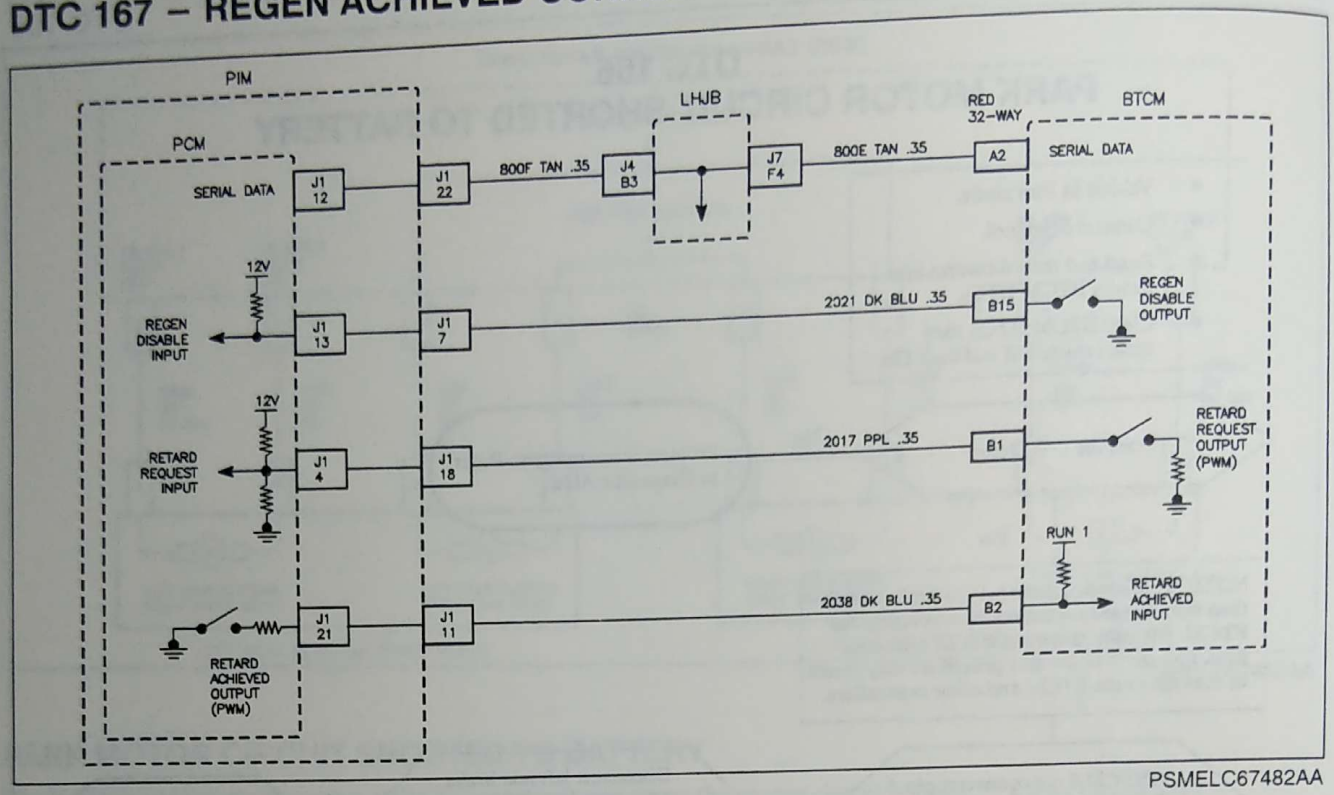
Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

DTC 166
PARK MOTOR CIRCUIT SHORTED TO BATTERY


Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On.
Does the DTC reset?
No
Problem is intermittent. Refer to Diagnostic Aids.
Yes
NOTICE: Disconnect the service brake switch then wait 10 seconds before disconnecting the BTCM. Disconnect the red BTCM connector first. Failure to follow this procedure may result in damage to the BTCM and other controllers.
Is BTCM 8 pin connector pin A showing a short to voltage?
Yes
Disconnect left rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin A still showing a short to voltage?
Yes
Repair short to voltage in circuit 2001.
No
Repair short to voltage in circuit 2003.
No
Is BTCM 8 pin connector pin H showing a short to voltage?
Yes
Disconnect right rear brake apply/park latch motor connector. Is BTCM 8 pin connector pin H still showing a short to voltage?
Yes
Repair short to voltage in circuit 1988.
No
Repair short to voltage in circuit 2004.
No
Is the resistance across BTCM 8 pin connector pins A and B less than 1.0 ohm?
Yes
Replace left rear brake apply motor.
No
Is the resistance across BTCM 8 pin connector pins H and C less than 1.0 ohm?
Yes
Replace right rear brake apply motor.
No
Replace BTCM.

DTC 167 – REGEN ACHIEVED CORRELATION FAILURE



PSMELC67482AA

REGEN ACHIEVED CORRELATION FAILURE

The brake torque control module (BTCM) receives a pulse width modulated signal from the propulsion control module (PCM) over the regen achieved line. Regen status is also reported to the BTCM by the PCM over the serial data line. If the serial data regen information does not match the regen achieved line the BTCM will turn On the SERVICE SOON telltale. Normal braking function will continue except for the ability to perform regen braking.

DTC PARAMETERS

DTC 167 will set if:

PCM failure.

DTC 167 will set when:

Anytime Run one is present, and regen is not taking place. This fault exists if the pulse width modulated (PWM) signal on the regen achieved line is not 18%, indicating a non-idle state (regen occurring), and the PCM serial data signal indicates the idle state of 18%.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally but there will be no regen blended into braking. This is a recoverable fault, which means that if the failure conditions are intermittent regen will resume when the failure conditions are not present.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

This DTC will be set during PCM reprogramming.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

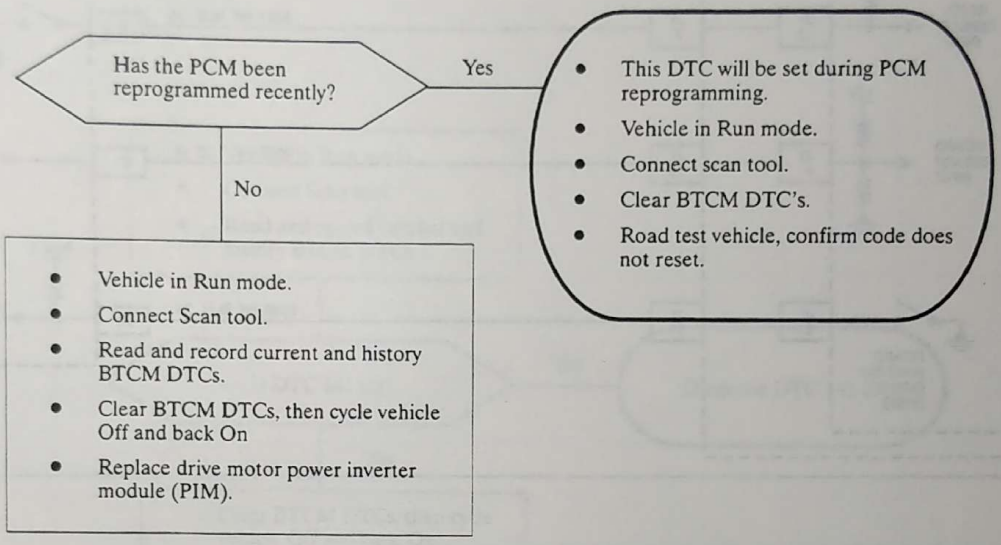
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

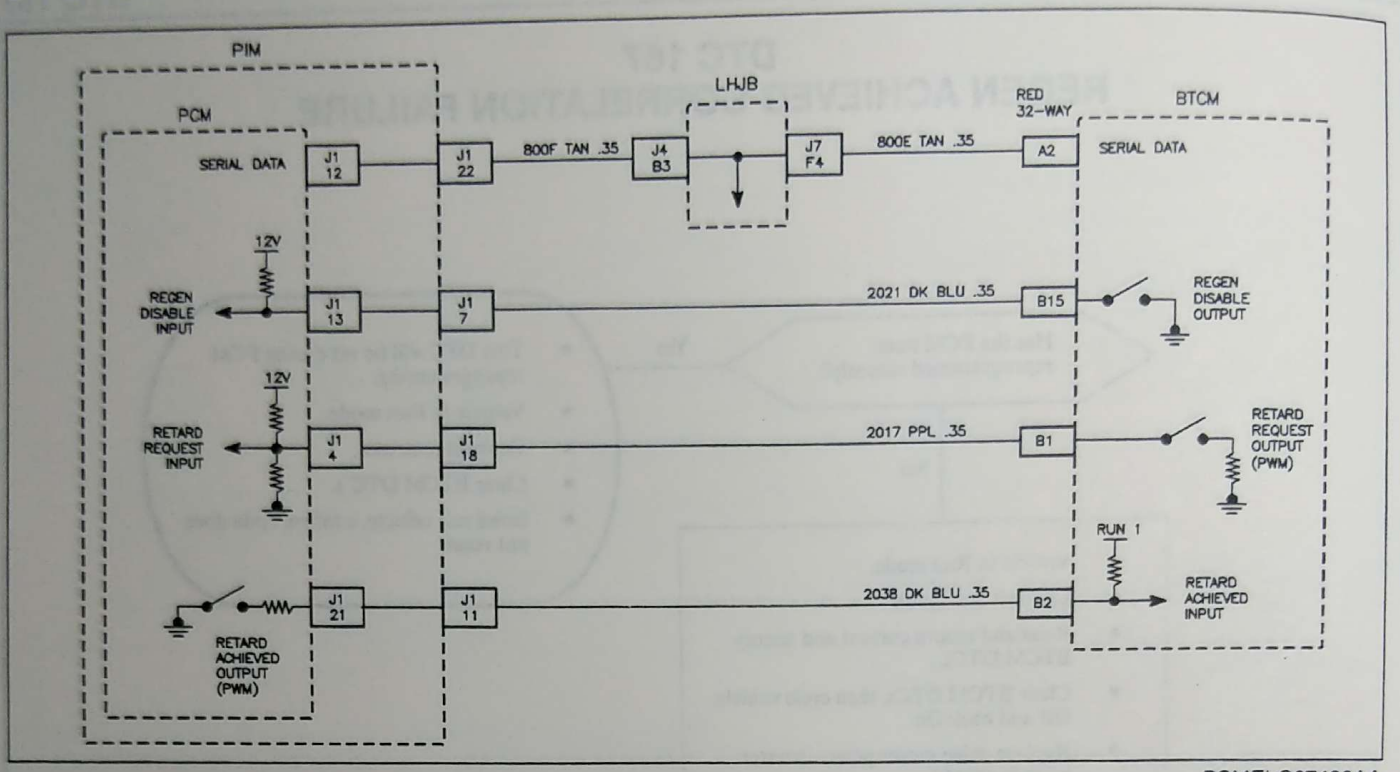
CamScanner

DTC 167
REGEN ACHIEVED CORRELATION FAILURE


Has the PCM been reprogrammed recently?
Yes
No
This DTC will be set during PCM reprogramming.
Vehicle in Run mode.
Connect scan tool.
Clear BTCM DTC's.
Road test vehicle, confirm code does not reset.
Vehicle in Run mode.
Connect Scan tool.
Read and record current and history BTCM DTCs.
Clear BTCM DTCs, then cycle vehicle Off and back On
Replace drive motor power inverter module (PIM).

CamScanner

DTC 168 – REGEN ACHIEVED DUTY CYCLE OUT OF RANGE



PSMELC67482AA

REGEN ACHIEVED DUTY CYCLE OUT OF RANGE

The brake torque control module (BTCM) receives a pulse width modulated signal from the propulsion control module (PCM) over the regen achieved line. If this signal goes out of range the BTCM will turn On the service soon telltale. Normal braking function will continue except for the ability to perform regen braking.

DTC PARAMETERS

DTC 168 will set if:

- Faulty regen achieved circuit.
- PCM failure.

DTC 168 will set when:

Anytime Run one is present and regen is not taking place. This fault exists if the pulse width modulated (PWM) signal on the regen achieved line is less than 5%, or more than 95%.

FAILURE ACTION

This is not a critical operational fault. The system will continue to function normally but there will be no regen blended into braking. This is a recoverable fault, which means that if the failure conditions are intermittent regen will resume when the failure conditions are not present.

RELATED DTCS

None

TELLTALE ILLUMINATED

SERVICE SOON

OTHER CONTROLLER INTERFACES

PCM

DIAGNOSTIC AIDS

This DTC will be set during PCM reprogramming.

When attempting to diagnose an intermittent problem, use the Scan tool* and review malfunction history diagnostic information. This data can be used to determine the conditions that were present when the DTC set.

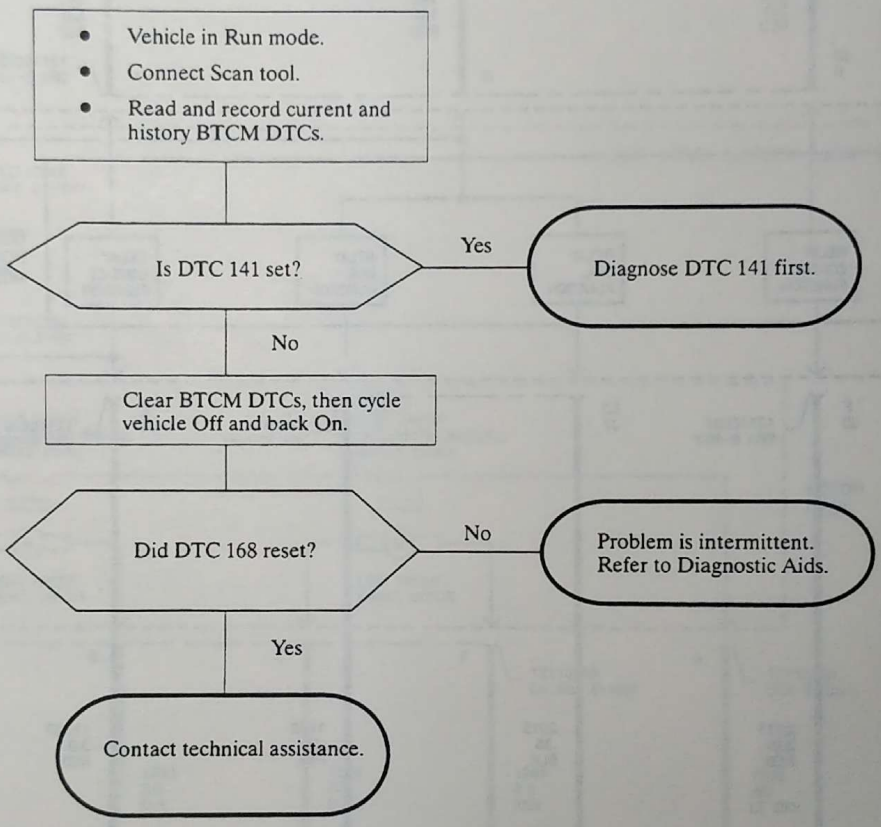
*Select Malf History from the Scan tool BTCM menu.

Check the tightness of the female terminal grip with a spare male terminal.

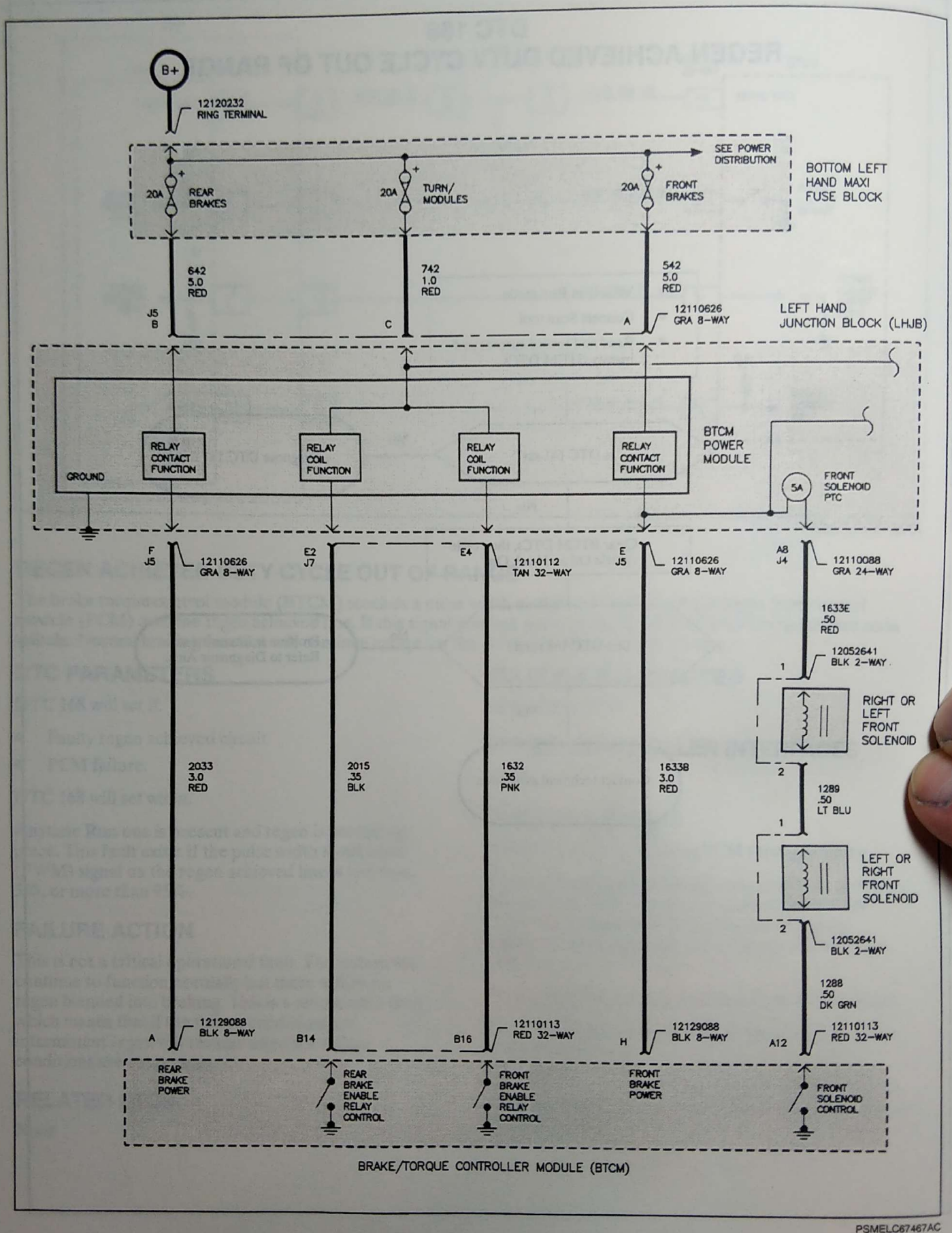
If the problem is intermittent wiggle the wire harness while viewing the Scan tool and see if the value changes or the DTC sets.

CamScanner

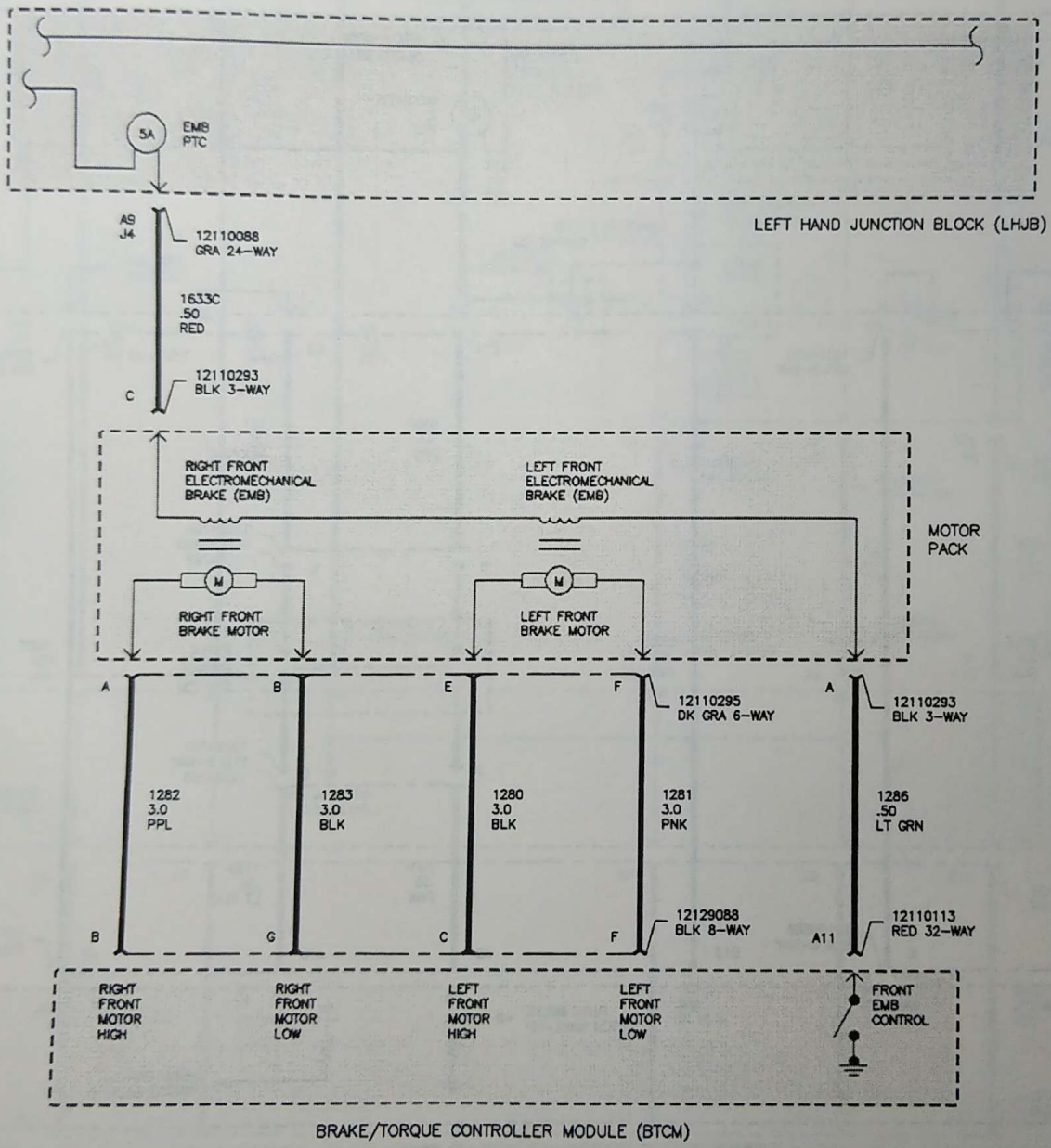
DTC 168
REGEN ACHIEVED DUTY CYCLE OUT OF RANGE



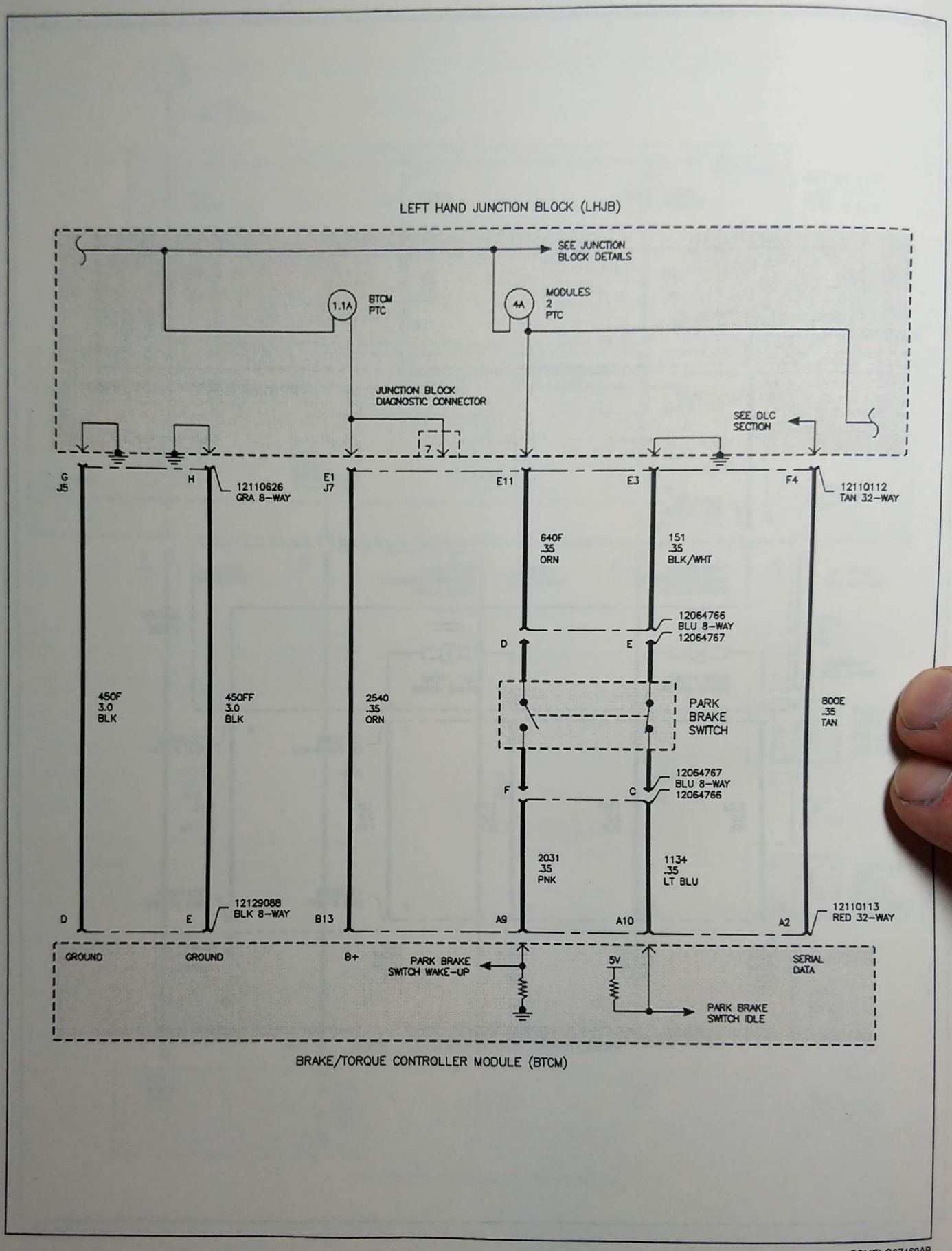
BRAKE SYSTEM SCHEMATIC



PSMELC67467AC



PSMELC67468AA



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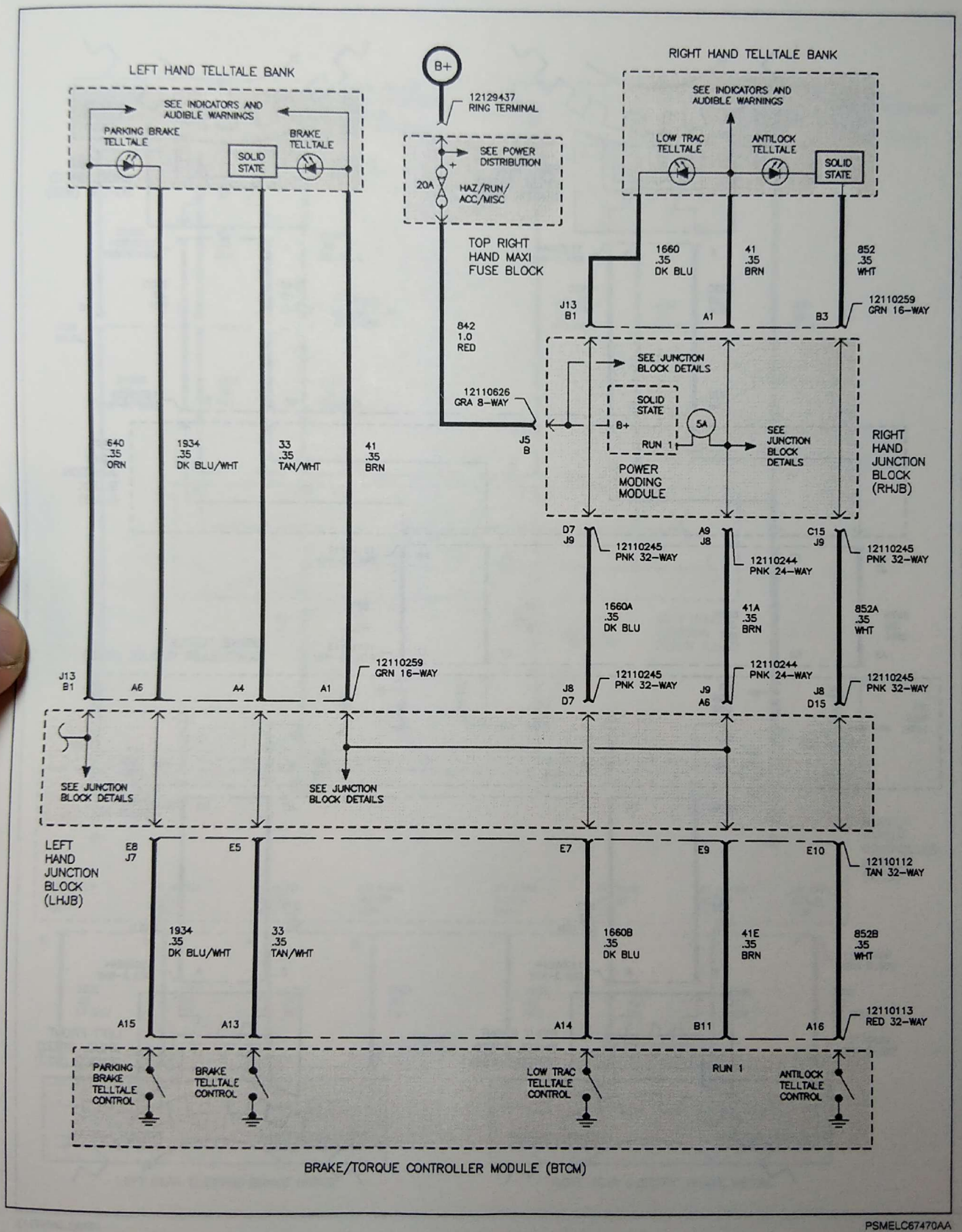
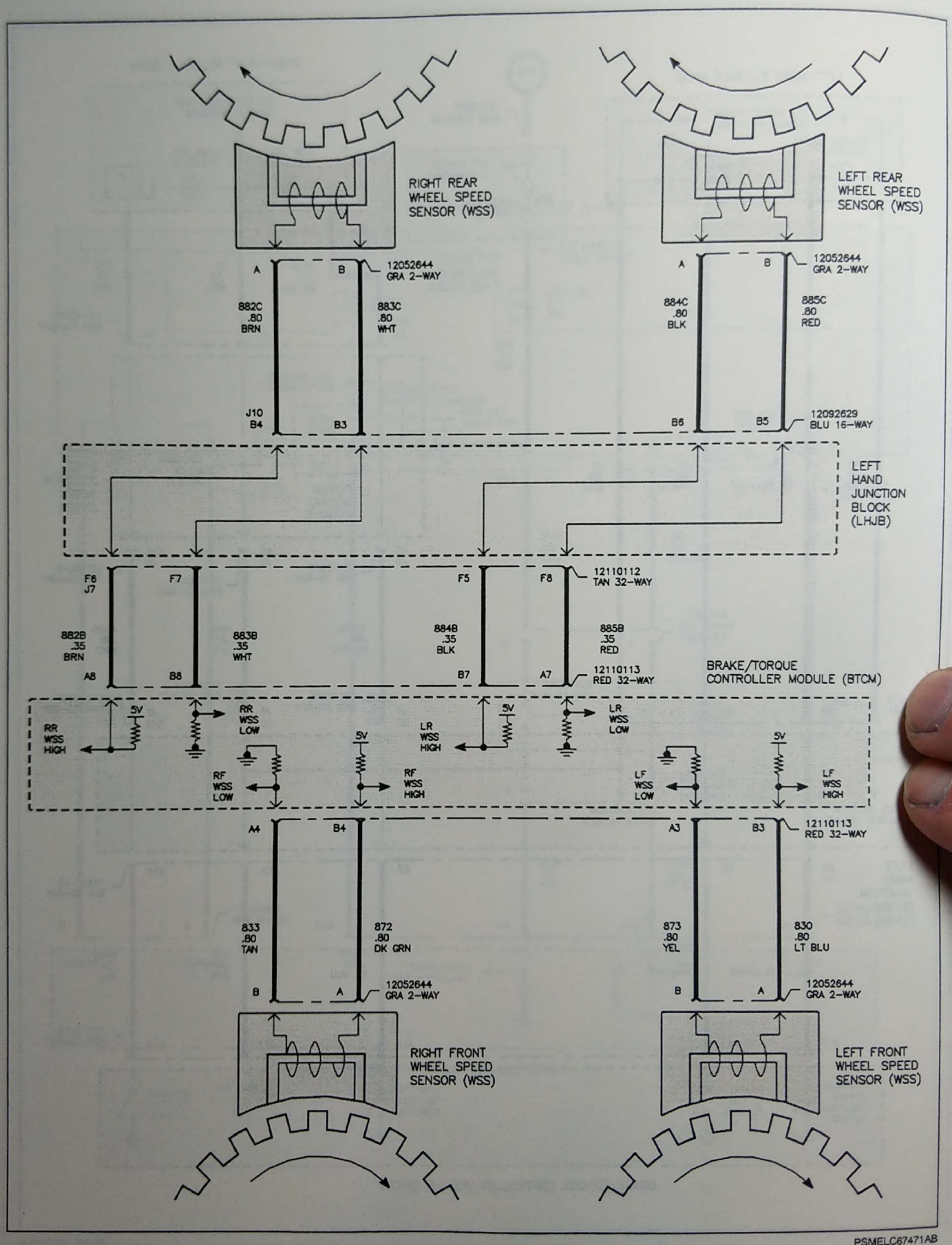
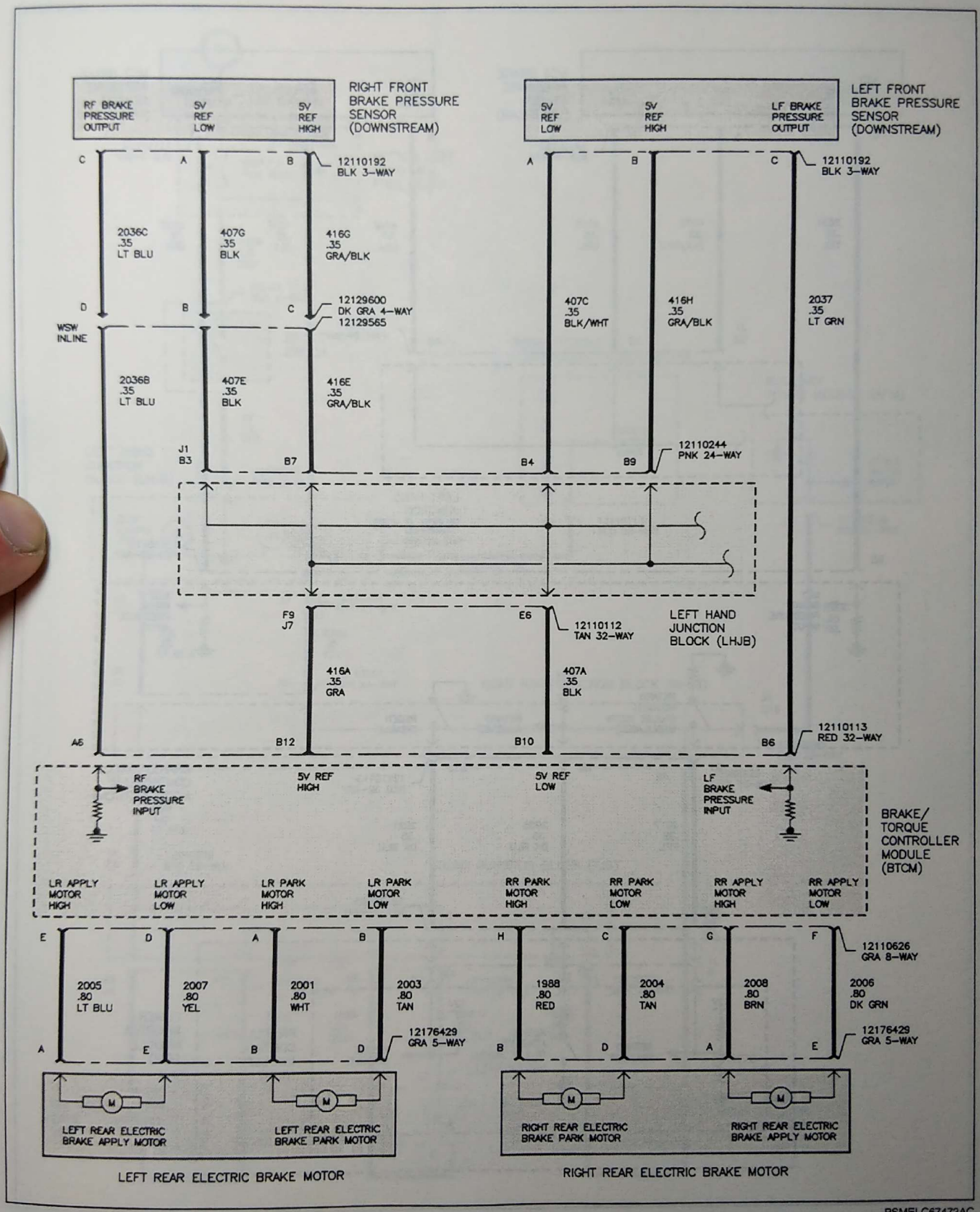
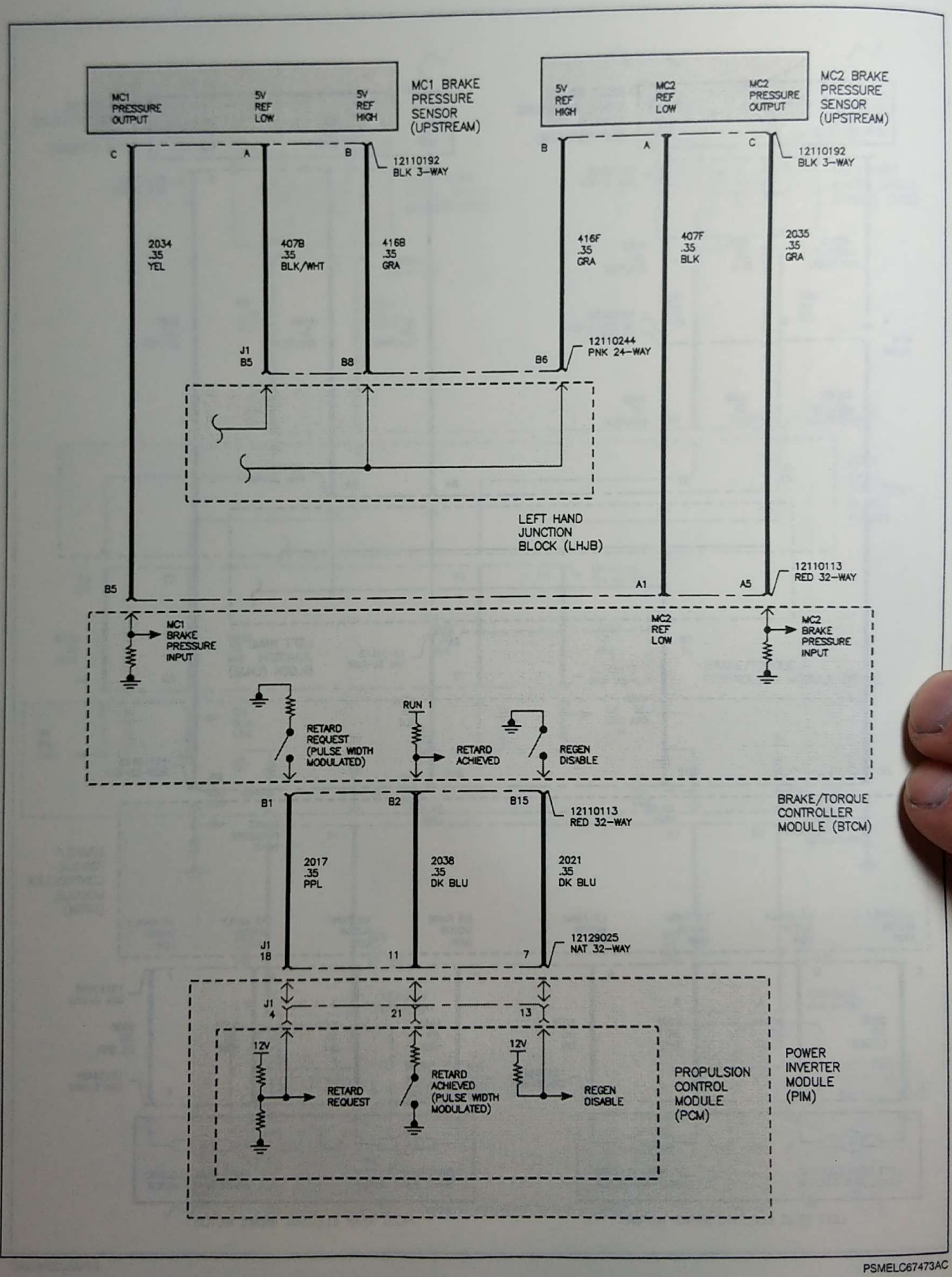


PSMELC67470AA

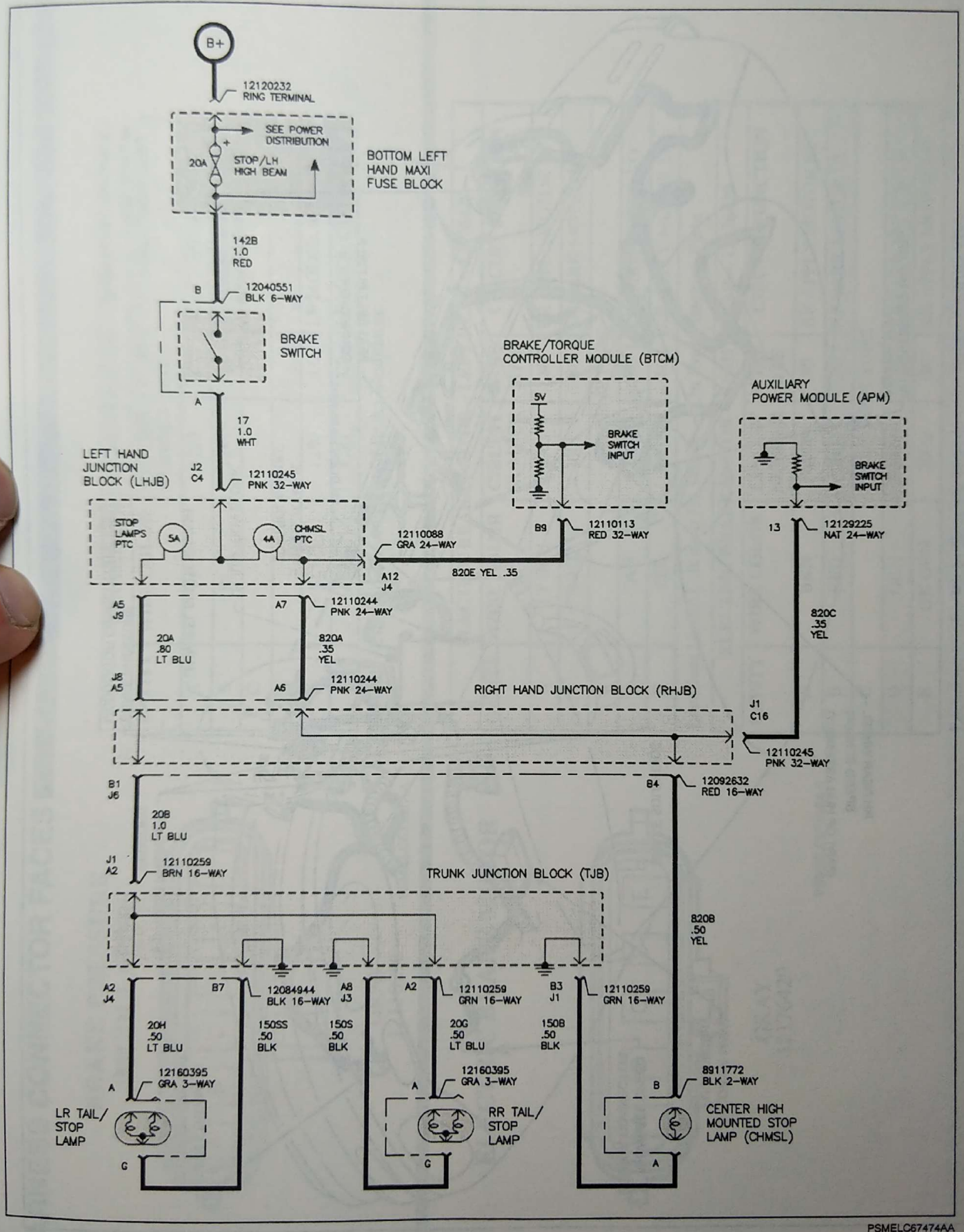

RIGHT REAR WHEEL SPEED SENSOR (WSS)
LEFT REAR WHEEL SPEED SENSOR (WSS)
A
B
12052644 GRA 2-WAY
882C .80 BRN
883C .80 WHT
884C .80 BLK
885C .80 RED
J10 B4
B3
B6
B5
12092629 BLU 16-WAY
LEFT HAND JUNCTION BLOCK (LHJB)
F6 J7
F7
F5
F8
12110112 TAN 32-WAY
882B .35 BRN
883B .35 WHT
884B .35 BLK
885B .35 RED
A8
B8
B7
A7
12110113 RED 32-WAY
BRAKE/TORQUE CONTROLLER MODULE (BTCM)
5V
RR WSS HIGH
RR WSS LOW
LR WSS HIGH
LR WSS LOW
RF WSS LOW
RF WSS HIGH
LF WSS LOW
LF WSS HIGH
A4
B4
A3
B3
12110113 RED 32-WAY
833 .80 TAN
872 .80 DK GRN
873 .80 YEL
830 .80 LT BLU
B
A
12052644 GRA 2-WAY
RIGHT FRONT WHEEL SPEED SENSOR (WSS)
LEFT FRONT WHEEL SPEED SENSOR (WSS)
PSMELC67471AB



PSMELC67472AC

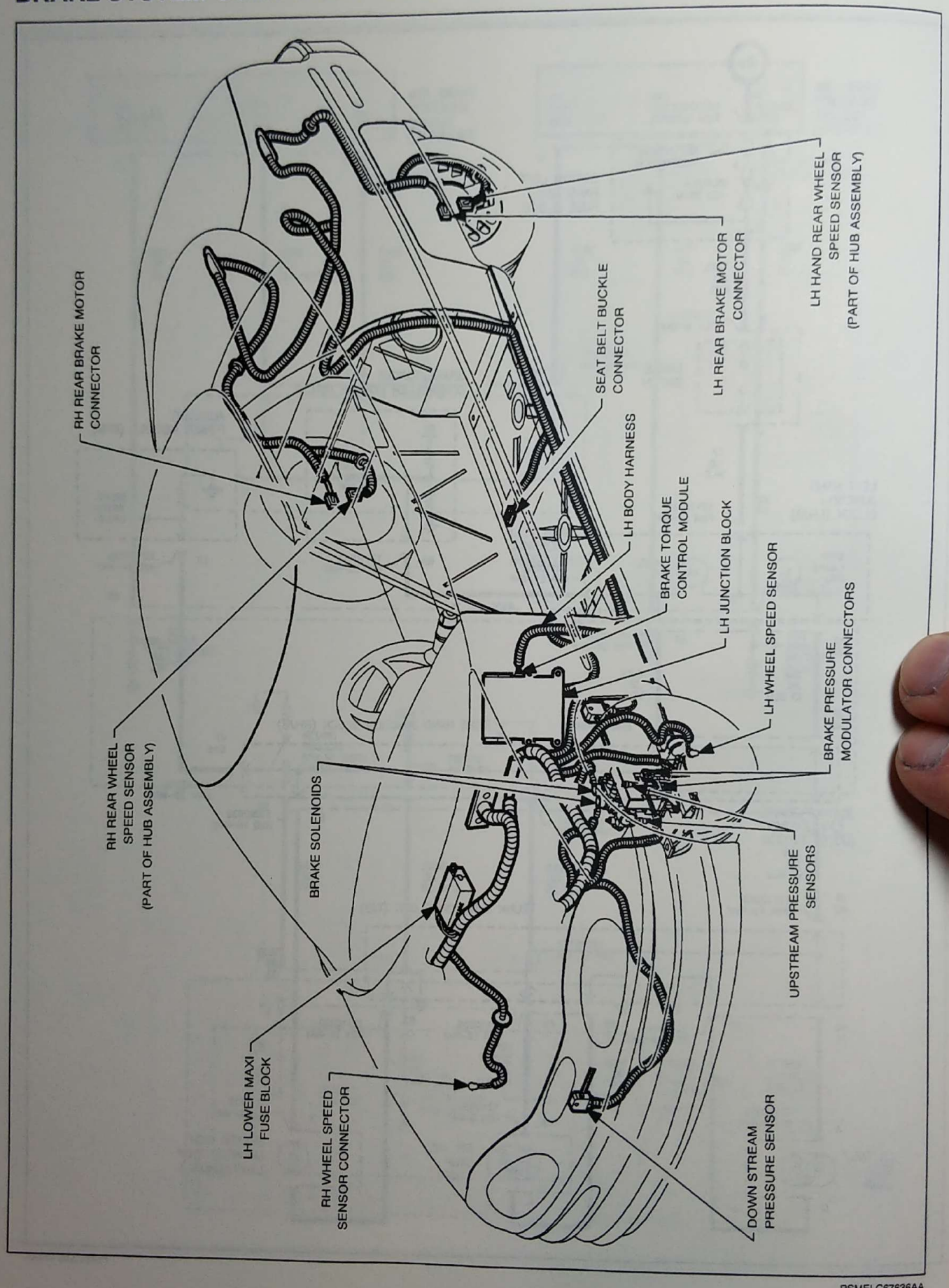


PSMELC67473AC



PSMELC67474AA

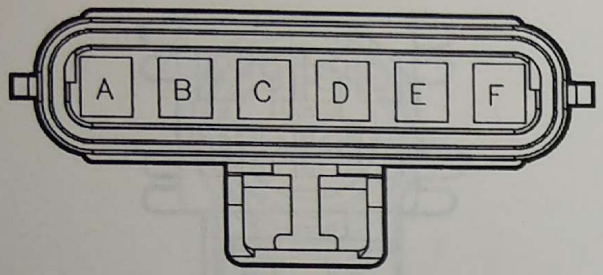
BRAKE SYSTEM COMPONENT LOCATION VIEW


RH REAR BRAKE MOTOR CONNECTOR
RH REAR WHEEL SPEED SENSOR (PART OF HUB ASSEMBLY)
BRAKE SOLENOIDS
LH LOWER MAXI FUSE BLOCK
RH WHEEL SPEED SENSOR CONNECTOR
DOWN STREAM PRESSURE SENSOR
UPSTREAM PRESSURE SENSORS
BRAKE PRESSURE MODULATOR CONNECTORS
LH WHEEL SPEED SENSOR
LH JUNCTION BLOCK
BRAKE TORQUE CONTROL MODULE
LH BODY HARNESS
SEAT BELT BUCKLE CONNECTOR
LH REAR BRAKE MOTOR CONNECTOR
LH HAND REAR WHEEL SPEED SENSOR (PART OF HUB ASSEMBLY)

PSMELC67636AA

HARNESS CONNECTOR FACES

BRAKE PRESSURE MODULATOR



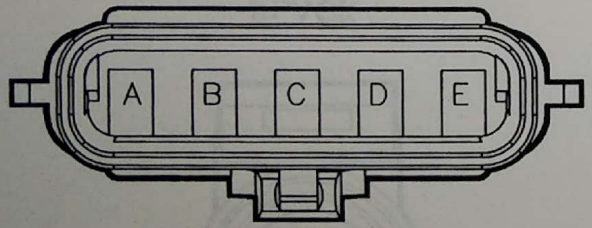
GRAY
12110295

PSMELC67567AA

BRAKE PRESSURE MODULATOR – 12110295				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	PPL	1282	3.0	RF MODULATOR HI
B	BLK	1283	3.0	RF MODULATOR LO
C				
D				
E	BLK	1280	3.0	LF MODULATOR HI
F	PPL	1281	3.0	LF MODULATOR LO

Location: Underhood – Bottom Of Brake Modulator

ELECTRIC BRAKE MOTOR



GRAY
12176429

PSMELC67568AA

ELECTRIC BRAKE MOTOR – LEFT REAR – 12176429				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	LT BLU	2005	.80	LR APPLY MOTOR HI
B	WHT	2001	.80	LR PARK MOTOR HI
C	VENT TUBE			
D	TAN	2003	.80	LR PARK MOTOR LO
E	YEL	2007	.80	LR APPLY MOTOR LO

Location: Under Left Rear Of Vehicle – On Brake Backing Plate

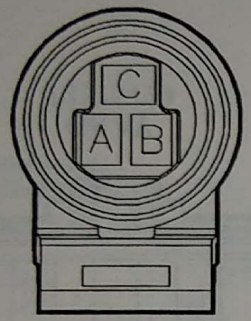
ELECTRIC BRAKE MOTOR – RIGHT REAR – 12176429				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BRN	2008	.80	RR APPLY MOTOR HI
B	RED	2002	.80	RR PARK MOTOR HI
C	VENT TUBE			
D	ORN	2004	.80	RR PARK MOTOR LO
E	DK GRN	2006	.80	RR APPLY MOTOR LO

Location: Under Right Rear Of Vehicle – At Brake Backing Plate

CamScanner

HARNESS CONNECTOR FACES

BRAKE PRESSURE SENSOR–DOWNSTREAM



BLACK
12110192

PSMELC67231AA

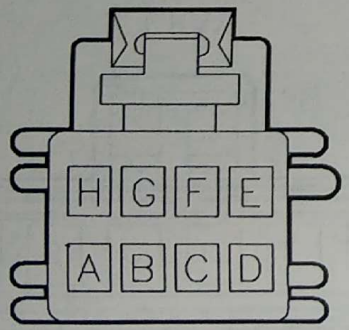
BRAKE PRESSURE SENSOR – LEFT FRONT – 12110192				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BLK	407C	.35	GROUND
B	GRA	416C	.35	+5V REF
C	LT GRN	2037	.35	LF BRAKE PRESSURE SIGNAL

Location: Underhood – Lower Front Center

BRAKE PRESSURE SENSOR – RIGHT FRONT – 12110192				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BLK	407G	.35	GROUND
B	GRA	416G	.35	+5V REF
C	LT BLU	2036C	.35	RF BRAKE PRESSURE SIGNAL

Location: Underhood – Attached to Right Side of Front Crossmember

PARK BRAKE SWITCH



BLUE
12064766

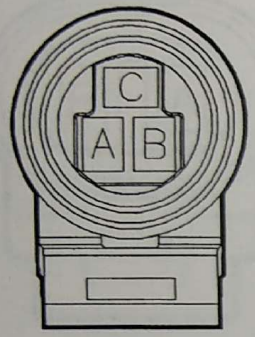
PSMELC67230AA

PARK BRAKE SWITCH – 12064766				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BLK	450Y	.35	GROUND
B			.35	
C	DK GRN	5410	.35	PARK BRAKE SWITCH IDLE OUT
D	ORN	640F	.35	B+
E	BLK/WHT	151	.35	GROUND
F	PNK	2031	.35	PARK BRAKE SWITCH WAKE-UP OUT
G				
H	BRN/WHT	230F	.35	DIMMER IN

Location: I/P Lower Left

CamScanner

MASTER CYLINDER (MC) PRESSURE SENSOR–UPSTREAM



BLACK
12110192

PSMELC67231AA

MASTER CYLINDER PRESSURE SENSOR – MC1 – 12110192				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BLK	407B	.35	GROUND
B	GRA	416B	.35	+5V REF
C	YEL	2034	.35	MC1 PRESSURE SIGNAL

Location: Underhood – Bottom Of Brake Modulator

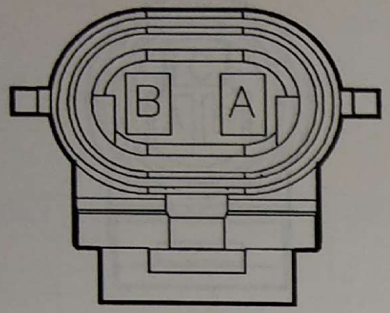
MASTER CYLINDER PRESSURE SENSOR – MC2 – 12110192				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BLK	450EE	.35	GROUND
B	GRA	416F	.35	+5V REF
C	GRA	2035	.35	MC2 PRESSURE SIGNAL

Location: Underhood – Bottom Of Brake Modulator

CamScanner

HARNESS CONNECTOR FACES

WHEEL SPEED SENSORS



LIGHT GRAY
12052644

PSMELC67178AA

WHEEL SPEED SENSOR – LEFT FRONT – 12052644				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	DK GRN	830	.50	WSS HI
B	TAN	873	.50	WSS LO

Location: At Left Front Wheel Bearing

WHEEL SPEED SENSOR – RIGHT FRONT – 12052644				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	DK GRN	872	.50	WSS HI
B	TAN	833	.50	WSS LO

Location: At Right Front Wheel Bearing

WHEEL SPEED SENSOR – LEFT REAR – 12052644				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BRN	882C	.80	WSS HI
B	WHT	883C	.80	WSS LO

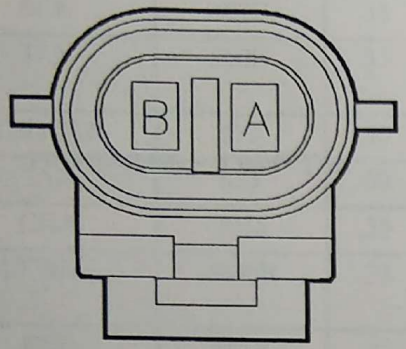
Location: At Left Rear Wheel Bearing

WHEEL SPEED SENSOR – RIGHT REAR – 12052644				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	BRN	884C	.80	WSS HI
B	WHT	885C	.80	WSS LO

Location: At Right Rear Wheel Bearing

CamScanner

BRAKE SOLENOID



BLACK
12052641

PSMELC67232AA

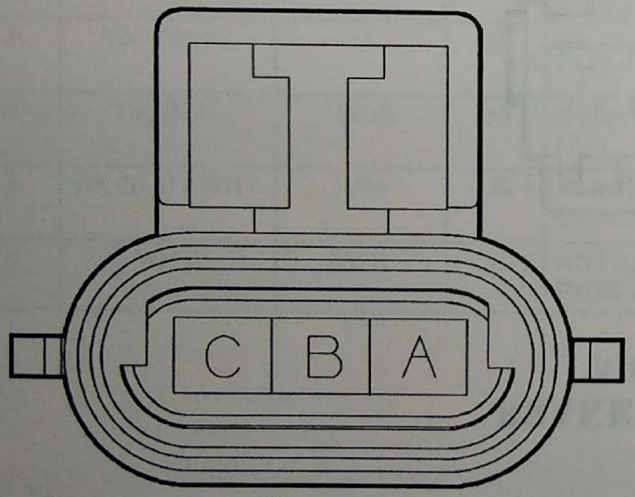
SOLENOID – LEFT FRONT – 12052641				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1	LT BLU	1289	.50	TO RF ABS SOLENOID
2	DK GRN	1288	.50	ABS SOLENOID CONTROL

Location: Underhood – Top Of Brake Modulator

SOLENOID – RIGHT FRONT – 12052641				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
1	RED	1633E	.50	ABS SOLENOID B+
2	LT BLU	1289	.50	TO LF ABS SOLE-NOID

Location: Underhood – Top Of Brake Modulator

FRONT ELECTROMECHANICAL BRAKE (EMB)



BLACK
12110293

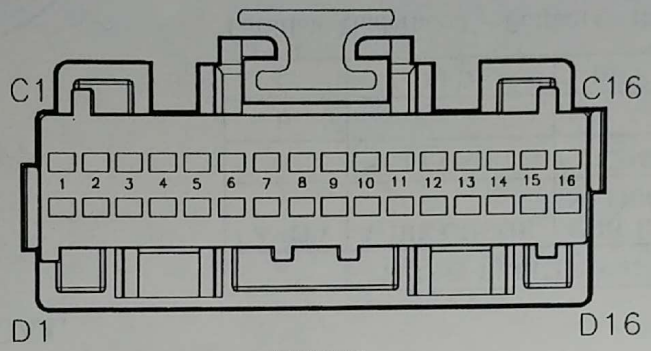
PSMELC66039AA

FRONT ELECTROMECHANICAL BRAKE (EMB) – 12110293				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	LT GRN	1286	.50	FRONT EMB CONTROL
B				
C	RED	1633C	.50	EMB B+

Location: Underhood – Bottom Of Brake Modulator

CamScanner

BRAKE TORQUE CONTROLLER MODULE (BTCM) – J1



12110113

DK RED
12110113

Location: I/P – Lower Left

PSMELC66035AA

BRAKE TORQUE CONTROLLER MODULE – J1 – 12110113

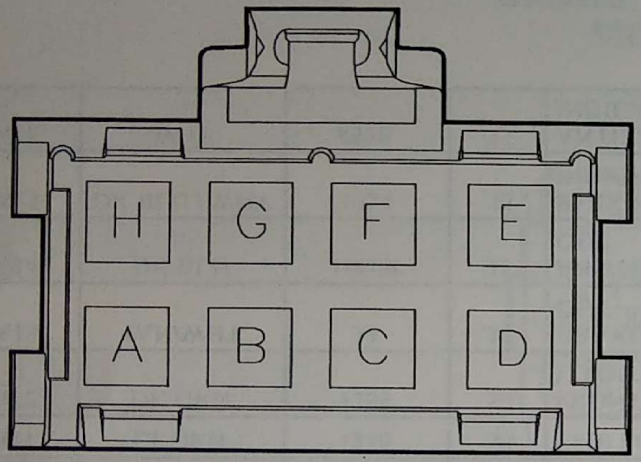
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A1	BLK	407F	.35	MC2 LO
A2	TAN	800E	.35	TO LH JUNCTION BLOCK SERIAL DATA
A3	YEL/TAN	873	.50	LF WSS LO IN
A4	TAN	833	.50	RF WSS LO IN
A5	GRA	2035	.35	MC2 IN
A6	LT BLU	2036B	.35	RF BRAKE PRESSURE SENSOR IN
A7	RED	885B	.35	LR WSS LO IN
A8	BRN	882B	.35	RR WSS HI IN
A9	PNK	2031	.35	PARK BRAKE SWITCH IN
A10	LT BLU	1134	.35	PARK BRAKE SWITCH IN
A11	LT GRN	1286	.50	EMB LO OUT
A12	DK GRN	1288	.50	FRONT SOLENOIDS LO OUT
A13	TAN/WHT	33	.35	BRAKE INDICATOR OUT
A14	DK BLU	1660B	.35	ABS/TCS INDICATOR OUT
A15	DK BLU / WHT	1934	.35	PARKING BRAKE INDICATOR OUT
A16	WHT	852B	.35	ANTILOCK INDICATOR

CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
B1	PPL	2017	.35	RETARD REQUEST OUT
B2	DK BLU	2038	.35	RETARD ACHIEVED IN
B3	DK GRN	830	.50	LF WSS HI IN
B4	DK GRN	872	.50	RF WSS HI IN
B5	YEL	2034	.35	MC1 IN
B6	LT GRN	2037	.35	LF BRAKE PRESSURE SENSOR IN
B7	BLK	884B	.35	LR WSS HI
B8	WHT	883B	.35	RR WSS LO IN
B9	YEL	820E	.35	BRAKE SWITCH IN
B10	BLK	407A	.35	GROUND
B11	BRN	41E	.35	BTCM RUN 1
B12	GRA	416A	.35	5V REF OUT
B13	ORN	2540	.35	BTCM B+
B14	BLK	2015	.35	REAR BRAKE ENABLE RELAY OUT
B15	PNK	2021	.35	REGEN DISABLE OUT
B16	PNK	1632	.35	FRONT BRAKE ENABLE RELAY OUT

CamScanner

HARNESS CONNECTOR FACES

BRAKE TORQUE CONTROLLER MODULE (BTCM) – J2



LT GRAY
12110626

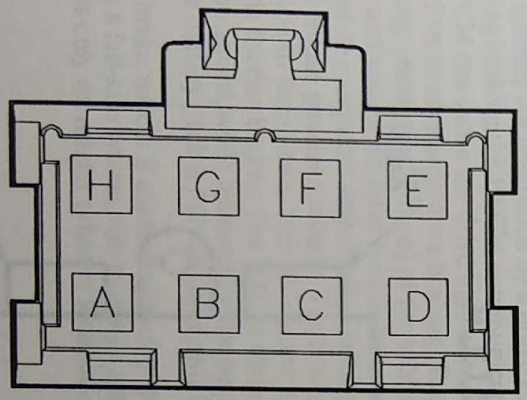
PSMELC66036AA

BRAKE TORQUE CONTROLLER MODULE – J2 – 12110626				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	WHT	2001	.80	LR PARK MOTOR HI OUT
B	TAN	2003	.80	LR PARK MOROR LO OUT
C	ORN	2004	.80	RR PARK MOTOR LO OUT
D	YEL	2007	.80	LR APPLY MOTOR LO OUT
E	LT BLU	2005	.80	LR APPLY MOTOR HI OUT
F	DK GRN	2006	.80	RR APPLY MOTOR LO OUT
G	BRN	2008	.80	RR APPLY MOTOR HI OUT
H	RED	2002	.80	RR PARK MOTOR HI OUT

Location: I/P – Lower Left

CamScanner

BRAKE TORQUE CONTROLLER MODULE (BTCM) – J3



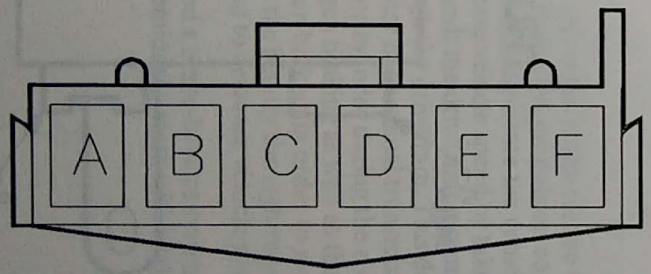
BLACK
12129088

PSMELC66037AA

BRAKE TORQUE CONTROLLER MODULE – J3 – 12129088				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	RED	2033	3.0	REAR BRAKE B+
B	PPL	1282	3.0	RF MOTOR HI OUT
C	BLK	1280	3.0	LF MOTOR HO OUT
D	BLK	450F	3.0	GROUND
E	BLK	450FF	3.0	GROUND
F	PNK	1281	3.0	LF MOTOR LO OUT
G	BLK	1283	3.0	RF MOTOR LO OUT
F	RED	1633B	3.0	FRONT BRAKE B+

Location: I/P – Lower Left

STOPLAMP SWITCH



BLACK
12040551

PSMELC67258AA

STOPLAMP SWITCH – 12040551				
CAVITY	WIRE COLOR	CIRCUIT NUMBER	WIRE SIZE	CIRCUIT FUNCTION
A	WHT	17	1.0	B+ OUT TO STOP LAMPS
B	RED	142B	1.0	B+
C	BRN	41R	.80	RUN 1
D	BRN	86B	.80	BRAKE SWITCH OUT TO PCM
E				
F				

Location: I/P – Above Brake Pedal

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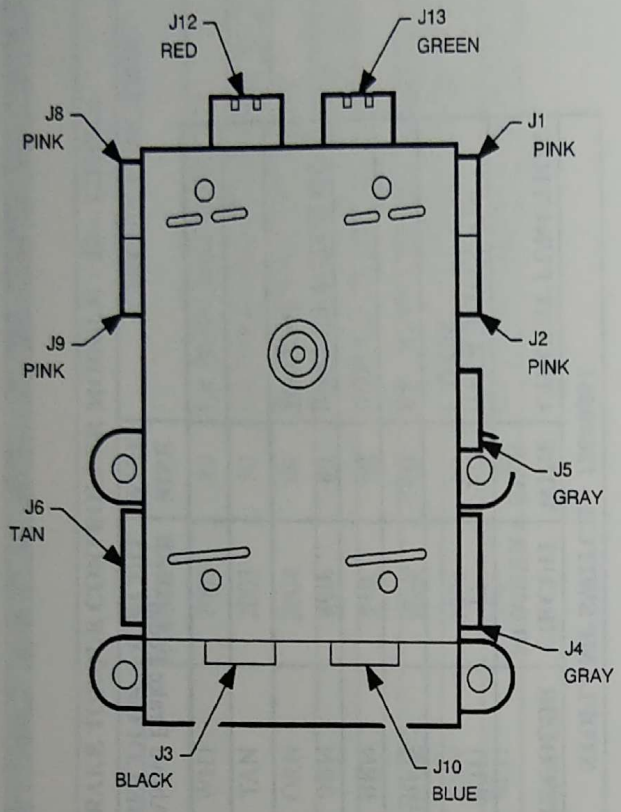
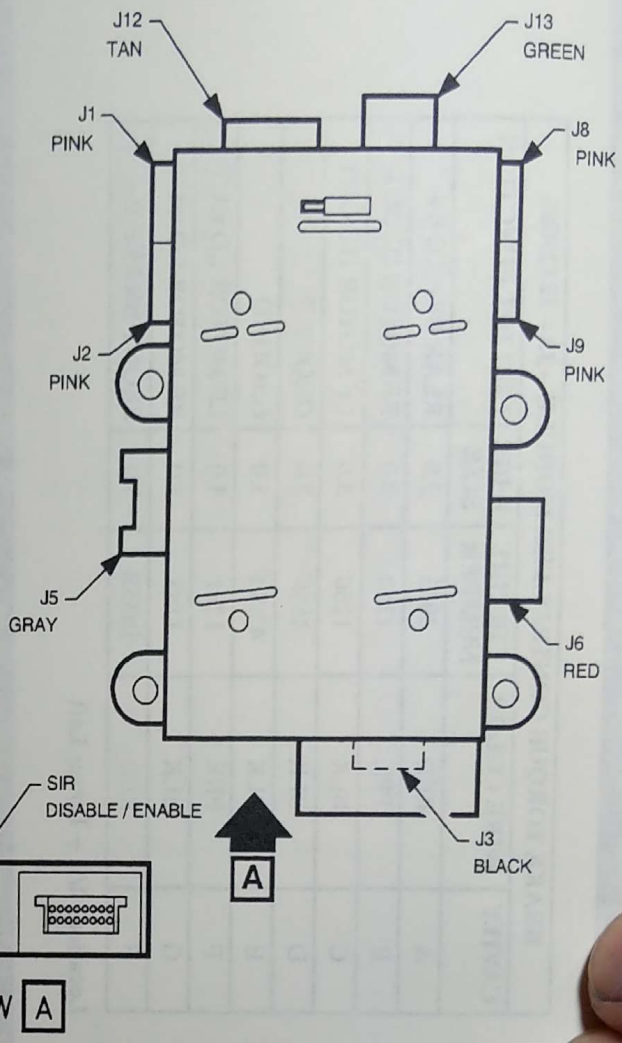
LH JUNCTION BLOCK

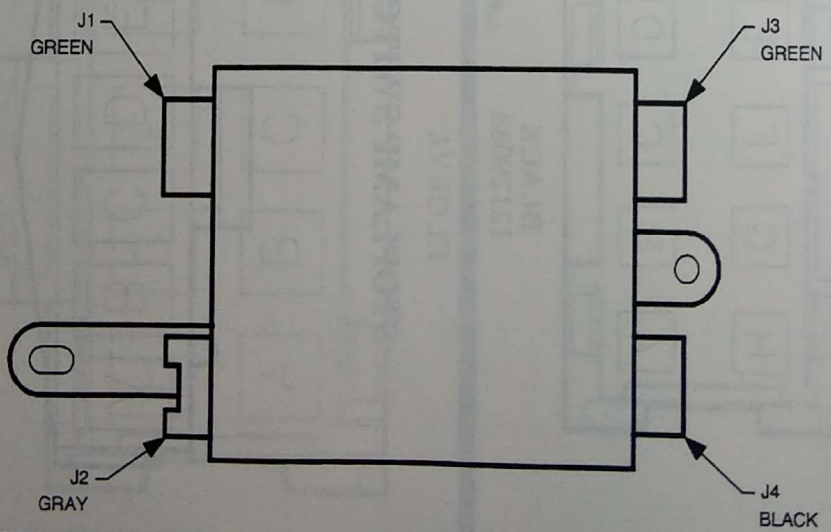


RH JUNCTION BLOCK



VIEW A

TRUNK JUNCTION BLOCK



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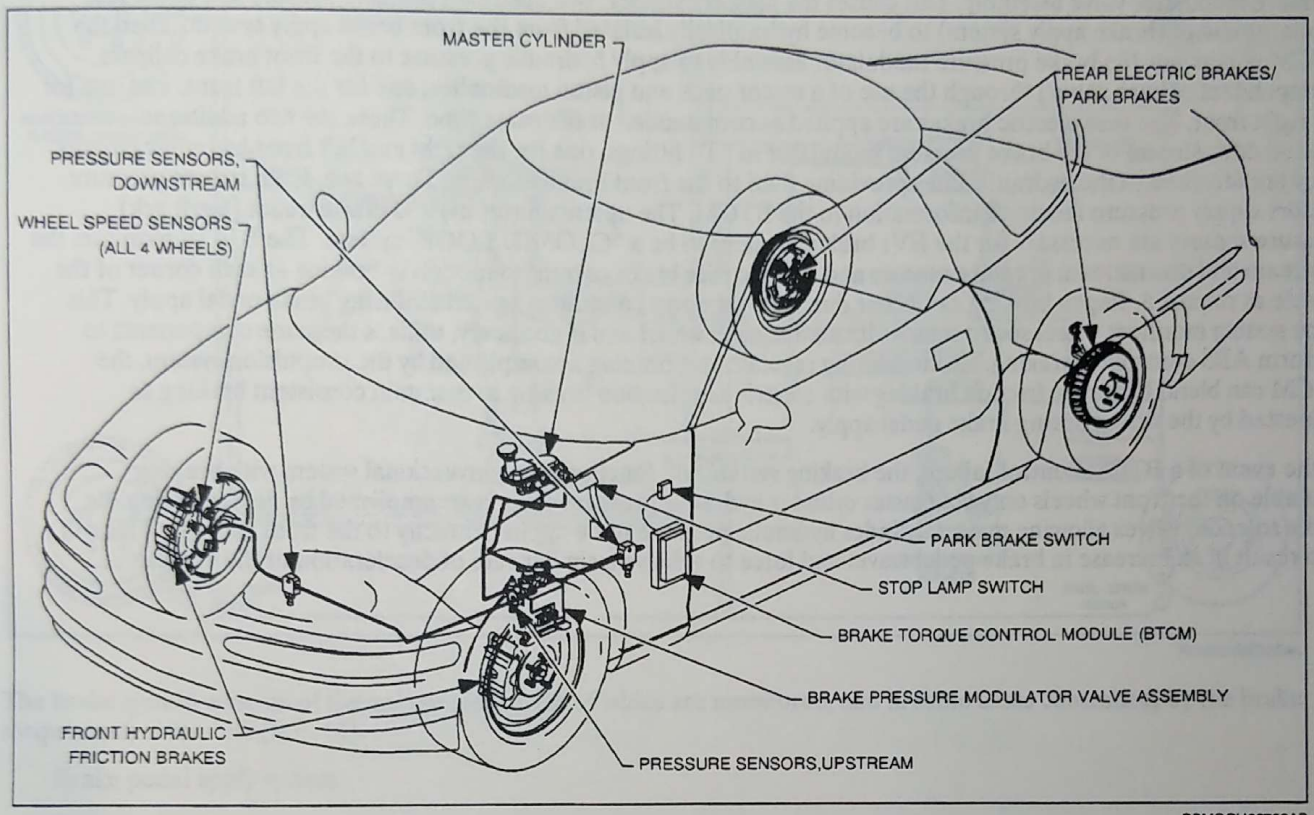
GENERAL INFORMATION

BRAKE SYSTEM OPERATION



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The EV1 vehicle utilizes a electrohydraulic brake system that incorporates three methods of braking to decrease vehicle speed:

- Front friction braking (Hydraulic)
- Rear friction braking (Electric)
- Front regenerative braking

Each of these systems are controlled by a brake controller (microprocessor) called the brake torque control module (BTCM). During braking the BTCM communicates with another controller called the propulsion control module (PCM). The PCM can cause the drive unit motor to function as a generator and decelerate the vehicle using the drive motor. This is known as regenerative braking (Regen). Regen helps to decrease vehicle speed by taking advantage of the *Kinetic Energy* (energy of motion) of the vehicle. When the PCM commands the drive unit motor to function as a generator, the unit's negative rotor torque is transferred to the wheels through the drivetrain. This drive motor resistance might be compared with a driver taking their foot off the accelerator of a manual transmission equipped gasoline/diesel engine powered vehicle. The internal resistance of each engine cylinder during the compression stroke causes the vehicle to decelerate. The EV1 brake system makes use of the regen braking as well as the front hydraulic and rear electric friction brakes. The BTCM blends friction braking and regen braking in order to maintain consistent braking as commanded, while maximizing the amount of energy returned to the battery through regeneration. However, if the battery pack is fully charged only friction braking will be used to decrease vehicle speed.

Since the EV1 brake system is controlled by the BTCM it could be considered a brake-by-wire system when no faults are present. As a fail-safe system, the braking system will function as a conventional system with braking available on the front wheels only via master cylinder hydraulic pressure.

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Applying the brake pedal activates the brake stop lamp switch (input) and provides hydraulic pressure to the two upstream pressure sensors. These two upstream pressure sensors are located on the pedal feel emulator attached to the brake pressure modulator valve. They are used to measure the brake pedal apply pressure via the master cylinder hydraulic pressure. They provide the input signal to request braking. When the BTCM sees two of these three inputs it will activate the electrohydraulic brake system by closing the normally open brake solenoid valves, located on the brake pressure modulator valve assembly. This causes the master cylinder, two upstream pressure sensors and pedal feel emulator circuit (brake apply system) to become hydraulically isolated from the front brake apply system. Then the BTCM commands the brake pressure modulator assembly to apply hydraulic pressure to the front brake calipers (independent of each other) through the use of a motor pack and piston assemblies, one for the left front, and one for the right front. The rear electric brakes are applied as commanded at the same time. There are two additional sensors located downstream of the brake pressure modulator in "T" fittings, one for the right and left front hydraulic circuits. They are attached to the hydraulic lines providing fluid to the front brake calipers. These two down stream pressure sensors supply pressure feedback information to the BTCM. The upstream (input) and downstream (feedback) pressure sensors are necessary for the EV1 braking system to be a "CLOSED LOOP" system. The BTCM monitors the upstream and downstream pressure sensors and electric rear brake current to modulate braking at each corner of the vehicle as required. Regen braking can occur during coast down conditions as well as during brake pedal apply. This same system monitors wheel speed sensors located at each wheel and if necessary, utilizes the same components to perform ABS controlled braking. By monitoring regenerative braking accomplished by the propulsion system, the BTCM can blend hydraulic friction braking with electric rear friction braking to maintain consistent braking as requested by the driver during brake pedal apply.

In the event of a BTCM control failure, the braking system will function as a conventional system with braking available on the front wheels only via master cylinder hydraulic pressure. This is accomplished by de-energizing the brake solenoid valves allowing master cylinder hydraulic pressure to be applied directly to the front calipers. This will also result in an increase in brake pedal travel and force to achieve a similar rate of deceleration of the vehicle.

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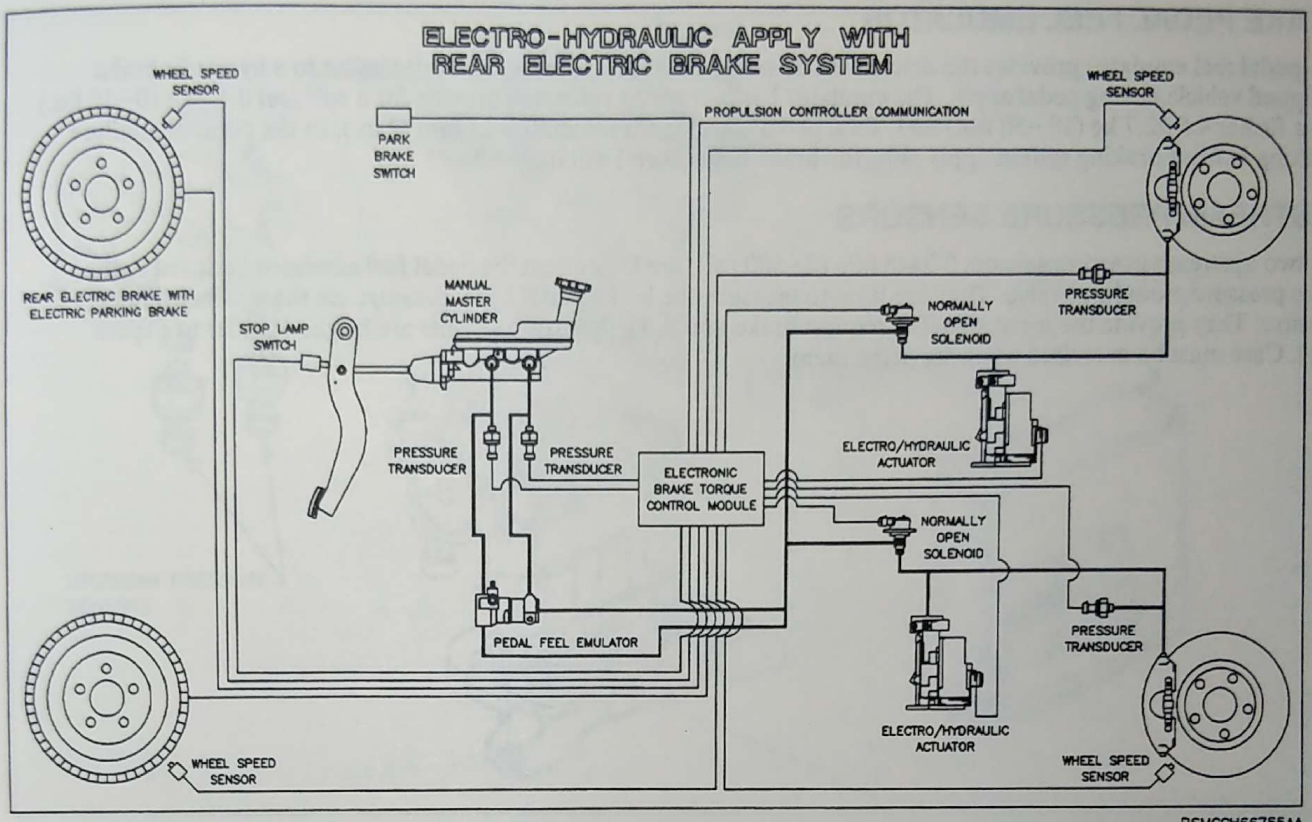

The brake system consists of five sub-systems, each of which are monitored, and in some cases controlled, by the brake torque control module (BTCM).

- Brake pedal apply system
- Front brake apply system
- Rear brake apply system
- Parking brake system
- Regenerative braking system

The BTCM monitors the brake applied force (by the driver) through the upstream pressure sensors, calculates brake apply forces at each wheel, supplies brake apply commands (current and voltage) and then modulates all braking as necessary. The BTCM and all friction braking components receive their power from the vehicle's 12 volt system.

BRAKE PEDAL APPLY SYSTEM

This system consists of the brake pedal, pushrod, master cylinder, stop lamp switch, pedal feel emulator and two upstream pressure sensors. The pedal feel emulator and the two upstream pressure sensors (to monitor hydraulic pressure applied by the driver through the brake pedal) are part of the brake pressure modulator assembly.

BRAKE MASTER CYLINDER

The brake master cylinder used on the EV1 is a composite design (plastic reservoir and aluminum body) incorporating a front, right-to-left brake system split. The front port of the master cylinder feeds the right front hydraulic circuit. The rear port of master cylinder feeds the left front hydraulic circuit. It incorporates the functions of the standard master cylinder.

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BRAKE PEDAL FEEL EMULATOR

The pedal feel emulator provides the driver with a brake pedal feel (force and travel) similar to a hydraulic brake equipped vehicle during pedal apply. The emulator has two spring rates that provide for a soft feel 0-4.5 kg (0−10 lbs.) and a firmer 4.5-22.7 kg (10−50 lbs.) feel. Total pedal travel is approximately 51 mm (2 in.). In the event of a failure resulting in front braking system apply only, the brake pedal travel will increase.

UPSTREAM PRESSURE SENSORS

The two upstream pressure sensors 0-3448 kPa (0−500 psi), are located on the pedal feel emulator attached to the brake pressure modulator valve. They are used to measure the brake pedal apply pressure via the master cylinder pressure. They provide the input signal to request brake apply. The pressure sensors are fragile (similar to a spark plug). Care must be exercised when servicing them.

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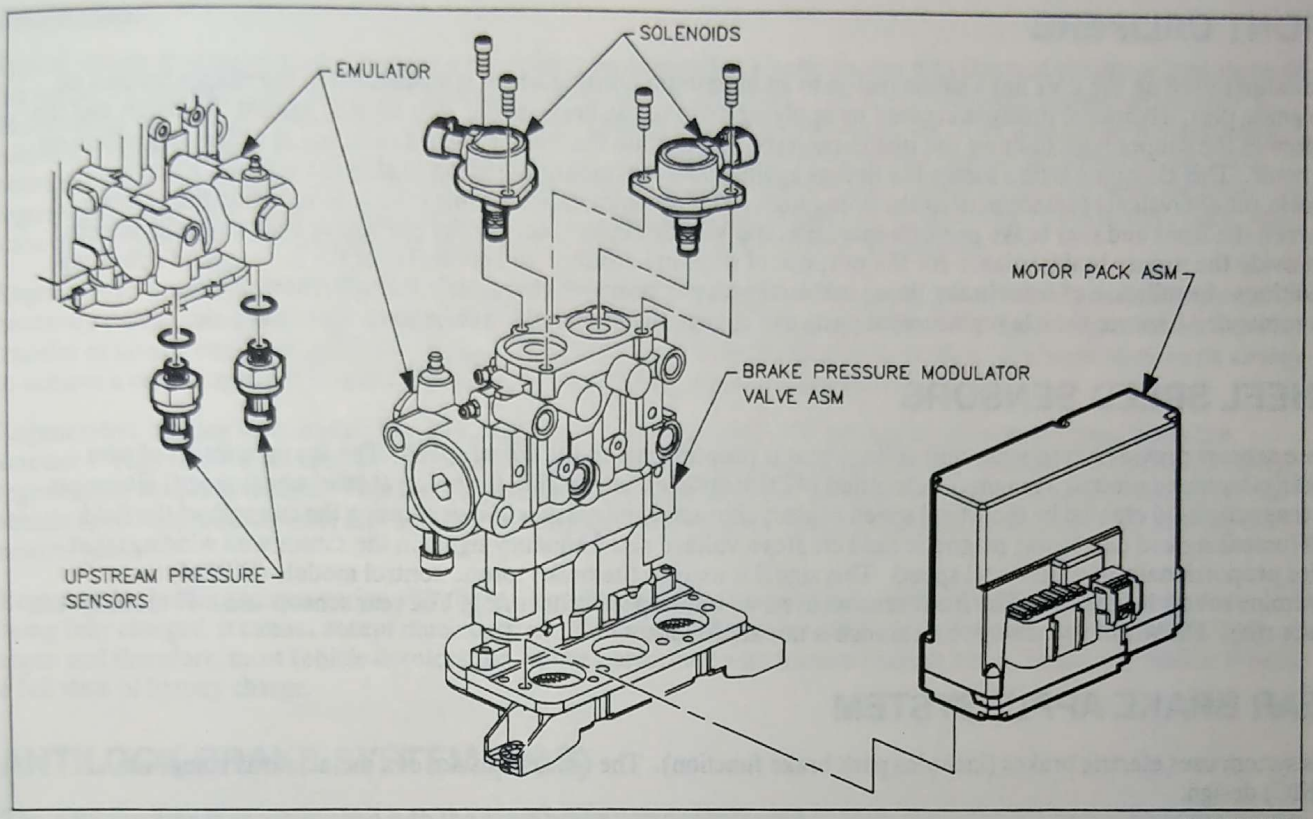

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FRONT BRAKE APPLY SYSTEM

This system consists of the brake pressure modulator valve assembly (electrohydraulic). It includes two solenoids, motor pack assembly, piston assemblies, brake pipes and hoses with two downstream pressure sensors (feedback), and the knuckle assembly with rotor and caliper assembly.

BRAKE PRESSURE MODULATOR VALVE ASSEMBLY

This brake pressure modulator is similar to an ABS VI modulator body with taller solenoids. It also includes a pedal feel emulator with two upstream pressure sensors attached (part of the brake pedal apply system). Provisions for brake bleeding are included in this assembly.

The brake pressure modulator valve assembly applies hydraulic pressure to the front brake calipers independent of each other through the use of a motor pack and piston assemblies, one for the left front, and one for the right front. When no electrical power is supplied to the motors, the piston is held in a fixed position by electromagnetic brake (EMB) clutch mechanisms. These devices prevent the motors from turning. Each time the brakes are applied and released the EMBs along with other apply system parts being activated make an audible click−clack sound. Customers may comment about this sound, but it is a normal part of EV1 brake operation.

SOLENOIDS

The solenoids are normally open when no electrical power is applied to them. They are low−side driven (ground side switched). The solenoids are activated each time the brake pedal is applied to separate the brake pedal apply system from the front brake apply system. If power (electrical) is lost while brake is being applied, the solenoids will open even under hydraulic brake pressure to return the brake system to manual apply mode.

DOWNSTREAM PRESSURE SENSORS

The two downstream pressure sensors are located downstream of the brake pressure modulator assembly, in "T" fittings (one for the right and left front hydraulic circuits) and are attached to the hydraulic lines providing fluid to the front brake calipers. The pressure sensors 0-14480 kPa (0−2100 psi) supply pressure feedback information to the BTCM. The pressure sensors are fragile (similar to a spark plug). Care must be exercised when servicing them.

There are a total of four pressure sensors used in the EV1 braking system. The two upstream (input) and two downstream (feedback) pressure sensors are necessary for the EV1 braking system to be a "CLOSED LOOP" system.

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FRONT CALIPERS

The caliper used on the EV1 has a single piston in an aluminum housing which is suspended in the caliper bracket on two guide pins. Hydraulic pressure created by applying force to the brake pedal, acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor creating friction to stop the vehicle. Electric Vehicle (or equivalent) replacement brake lining material is recommended for this vehicle to maintain the balance between the front and rear brake performance. Electric Vehicle replacement brake parts have been carefully selected to provide the proper brake balance for the purpose of stopping distance and control over the full range of operating conditions. Installation of front brake lining material with performance characteristics different from the recommended Electric Vehicle replacement parts can change the intended brake balance for this vehicle.

WHEEL SPEED SENSORS

These sensors provide a frequency and voltage that is proportional to the wheel speed. The sensor consists of wire windings wrapped around a magnet. A toothed (47 teeth) speed sensor ring (spinning at road wheel speed) interrupts the magnetic field created by the wheel speed sensor; alternately increasing and decreasing the strength of the field. This increasing and decreasing magnetic field creates a voltage and frequency signal in the sensor wire windings that varies proportionally to road wheel speed. This signal is used by the brake torque control module (BTCM) to determine road wheel speed. The front sensors use a 48 tooth speed sensor ring. The rear sensors use a 47 tooth speed sensor ring. The wheel speed sensor clearance is not adjustable.

REAR BRAKE APPLY SYSTEM

This system uses electric brakes (includes park brake function). The rear drums are of a metal matrix composite (MMC) design.

The rear electric brake system utilizes drums and shoes with an electric motor pack (motor and gear assembly) used to apply the shoes rather than a hydraulic wheel cylinder.

The MMC rear brake drums are serviced by REPLACEMENT ONLY. Some moderate to heavy scoring of the drum surface is typical and is not detrimental to brake operation. SCORED APPEARANCE IS TYPICAL, DO NOT REFINISH/TURN. These drums have no balance weights attached to them. Replace drums for excessive wear (increased diameter), severe vibration, or excessive noise.

Electric Vehicle (or equivalent) replacement brake lining material is recommended for this vehicle to maintain the balance between the front and rear brake performance. Electric Vehicle replacement brake parts have been carefully selected to provide the proper brake balance for the purpose of stopping distance and control over the full range of operating conditions. Installation of rear brake lining material with performance characteristics different from the recommended Electric Vehicle replacement parts can damage the MMC rear brake drum as well as change the intended brake balance for this vehicle.

PARKING BRAKE SYSTEM

The park brakes are automatically applied each time the vehicle PRND selector is placed in the Park position. The park brakes can also be manually applied and released by pushing the park brake switch located to the left of the steering column. To release the park brake with the key pad in the LOCK position you must also press down on the brake pedal before depressing the park brake switch. When the park brake is locked an audible click sound may be heard in addition to the PARKING BRAKE telltale being illuminated. This PARKING BRAKE telltale will flash On/Off as the park brake is applied and remain on until the vehicle is powered down. Once the vehicle is placed in the Lock mode, the PARKING BRAKE telltale will remain On for five seconds, and then turn Off.

REGENERATIVE BRAKING SYSTEM

Acceleration and Cruise:

During vehicle acceleration and cruise conditions, potential energy (chemical) in the battery pack is converted to kinetic energy (energy of motion) in the vehicle by generating motor torque and speed resulting in vehicle motion (positive drive motor slip).

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Deceleration:

Typical vehicle braking systems decelerate the vehicle by converting kinetic energy into thermal energy or heat through the use of friction materials in contact with metal brake drums or rotors. The EV1 introduces another method of decelerating the vehicle called regenerative braking. During vehicle deceleration, the drive unit motor is electrically converted into a generator (negative drive motor slip). The kinetic energy of vehicle motion is converted back into potential energy as the generator charges the battery pack. The amount of vehicle deceleration available through regenerative braking is proportional to the amount of electrical current that can be sent back to the battery pack. The state of charge of the battery pack influences how readily the pack will accept this current.

Regenerative braking is not the answer to the perpetual motion machine. Applying the vehicle brakes more than is necessary during normal driving conditions will not increase the driving range of the EV1. Since regeneration is the transfer of kinetic energy to potential energy, the vehicle must be in motion for it to work. It always takes more energy to achieve a certain speed than what can be regained by using regen braking to stop.

Regenerative braking torque varies with vehicle speed. At high speeds the maximum drivetrain power limits the amount of regenerative braking torque available. As the vehicle speed drops below approximately 89 km/h (55 mph), regenerative torque increases. This torque peaks at vehicle speeds between 16 and 48 km/h (10 and 30 mph). As the vehicle speed approaches zero, regenerative braking torque is reduced to zero. There is no regenerative braking in neutral gear.

Regenerative braking torque varies with the state of charge of the battery pack. When the battery pack is close to being fully charged, it cannot accept much current. This means that there will be less available braking torque from regen and therefore, most vehicle deceleration will be performed with friction braking when the battery pack is close to a full state of battery charge.

ANTILOCK BRAKE SYSTEM (ABS)

The ABS function is accomplished with the same brake components used to apply the brakes. There is no regenerative braking during ABS events.

THE ABS STOPPING ADVANTAGE

A brake system needs tire traction to function. When wheel lock–up (tire skids, rather than rolls) occurs during braking, the amount of traction force between the tire and road surface decreases dramatically. Since traction force is necessary to slow or steer a vehicle, wheel lock–up during braking is extremely undesirable. Antilock brakes prevent wheel lock–up from occurring, providing shorter stopping distances on some surfaces, with greater steering control during braking than a non–antilock brake equipped vehicle. Stopping distance is dependent on many variables including but not limited to brake conditions, tire conditions, road surface conditions, and steering input.

TRACTION CONTROL SYSTEM (TCS)

The traction control system does not apply the brakes. It only reduces the acceleration command to keep the drive wheels from slipping during acceleration.

ENHANCED DRIVE CONTROL (EDC)

This system monitors the speed of the drive wheels during coastdown for impending wheel lock. It will reduce the amount of coastdown regenerative braking to prevent the wheels from locking.

BRAKE LIGHTS (TELLTALES)

The BTCM continuously monitors itself and other BTCM components. If a system problem is detected, one or more of the following four indicator lights will be illuminated.

RED BRAKE TELLTALE

The Red BRAKE light is illuminated when there is a brake system failure. When this light is illuminated brake system function may be degraded.

AMBER ANTILOCK TELLTALE

The Amber ANTILOCK light is illuminated when there is an antilock brake system failure. When this light is illuminated the ABS system will not function.

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RED PARK BRAKE TELLTALE

The PARKING BRAKE light will illuminate when the park brake is applied. It will flash during a park brake apply until the rear electric brakes are latched or if there is a park brake failure.

SERVICE SOON TELLTALE

The BTCM will cause the SERVICE SOON light to illuminate if a telltale or regen fault is detected.

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SERVICE PROCEDURES

BRAKE MASTER CYLINDER/RESERVOIR

REMOVAL

HIGH VOLTAGE DISABLE

CAUTION: TO REDUCE THE RISK OF SEVERE SHOCK AND BURNS THE HIGH VOLTAGE SYSTEM SHOULD BE DISABLED ANY TIME SERVICE WORK IS BEING PERFORMED ON OR AROUND THE HIGH VOLTAGE SYSTEM. WHEN IN DOUBT ALWAYS DISABLE THE HIGH VOLTAGE SYSTEM. THE 12 VOLT SYSTEM WILL STILL BE ACTIVE AFTER THE HIGH VOLTAGE SYSTEM HAS BEEN DISABLED.

1. Disable high voltage power supply. (Refer to "High Voltage Disable" procedure in this manual.)
2. Make sure brake lines and fittings at the master cylinder are clean prior to disconnecting fittings.

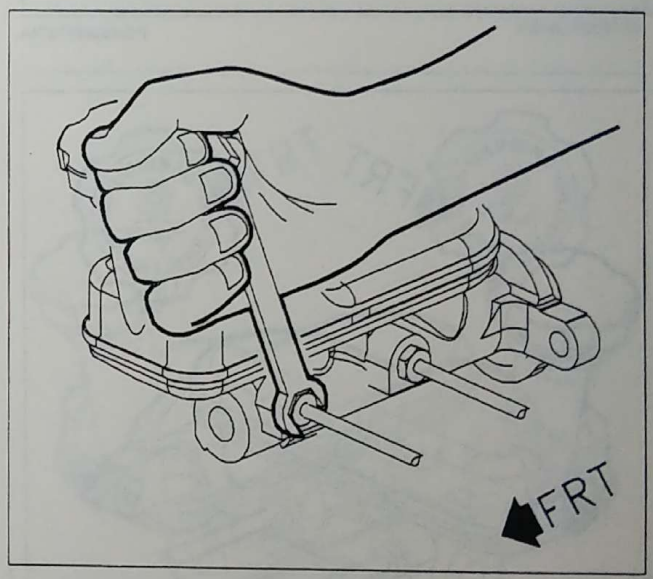
IMPORTANT: Place clean shop towel below master cylinder and brake line fittings in an effort to retain spent brake fluid.

3. Disconnect brake line fittings from master cylinder.

IMPORTANT: Use the appropriate size line wrench when loosening or tightening brake line fittings.

4. Plug off all brake fluid openings to prevent brake fluid loss and contamination.

NOTICE: After removing brake line fittings, do not excessively pull or bend brake lines away from master cylinder.



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NOTICE: Care must be taken to prevent brake fluid from contacting any painted surface and/or electrical connector.

5. Remove two nuts securing master cylinder to front of dash.

IMPORTANT: Be careful not to bend brake lines.

6. Remove master cylinder from vehicle.

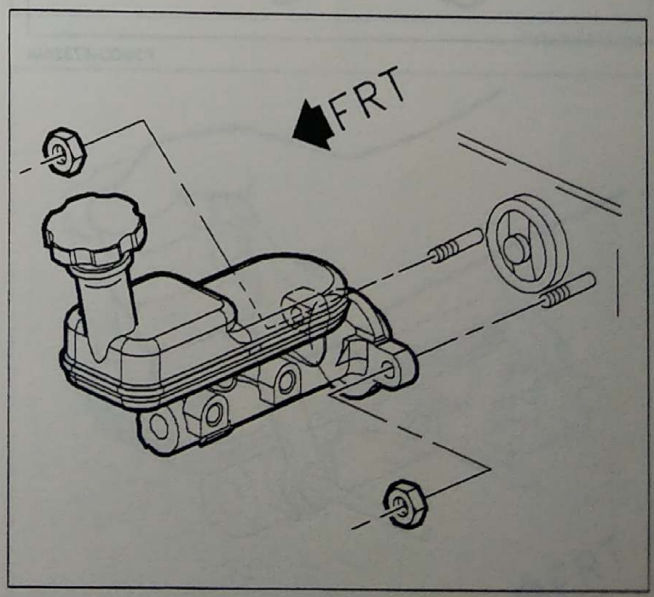
INSTALLATION

1. Position master cylinder onto studs at front of dash and install fastening nuts.

NOTICE: Check to make sure that the slot in the push rod is VERTICAL and that it aligns with the master cylinder.

Torque: 27 N•m (20 ft−lbs)

IMPORTANT: Be careful not to bend brake lines.



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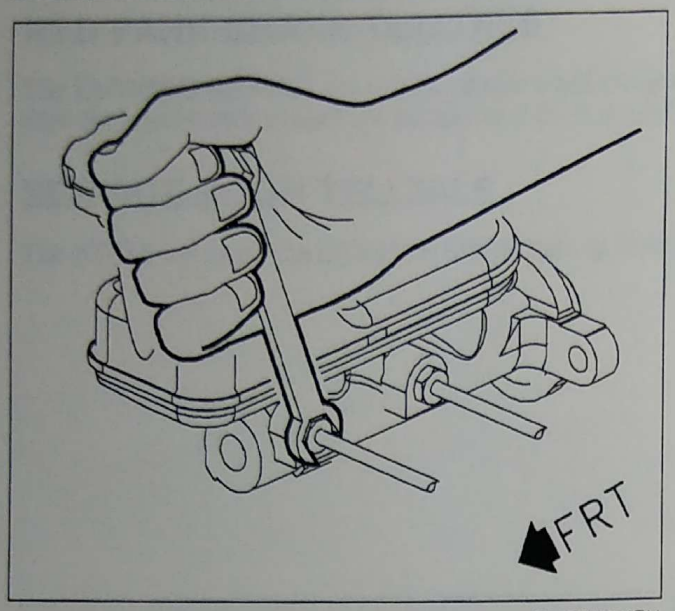

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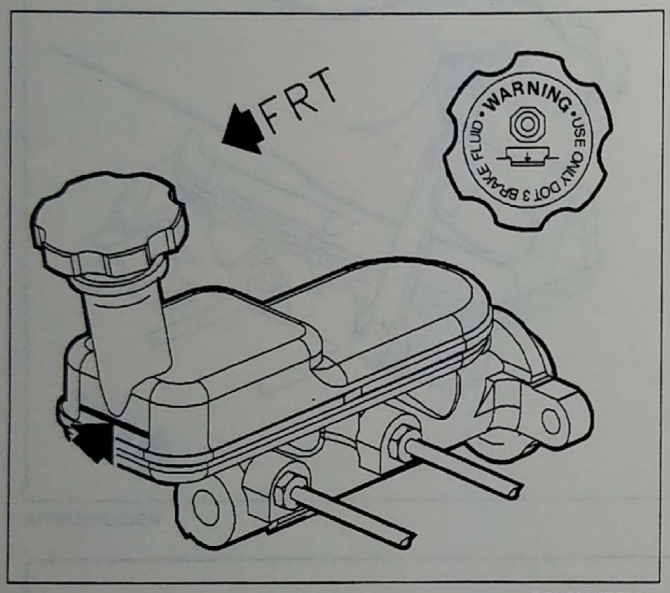
2. Position brake lines into the master cylinder and secure brake line fitting nuts.

IMPORTANT: Use the appropriate size line wrench when loosening or tightening brake line fittings.

Torque: 20 N•m (15 ft−lbs)



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3. Fill brake fluid reservoir with clean brake fluid up to the base of the reservoir fill neck.

IMPORTANT: Use only Delco Supreme 11, DOT 3 brake fluid P/N 12377967 (or equivalent) from a clean sealed container.

4. Bleed brake system. (Refer to "Brake System Bleeding" in this manual.)
5. Check brake fluid level.
6. Check for brake fluid leaks.
7. Check the brake pedal for "sponginess." Repeat entire bleeding procedure to correct this condition.
8. Enable high voltage power supply. (Refer to "High Voltage Enable" procedure in this manual.)

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BRAKE SYSTEM BLEEDING

MANUAL BLEEDING

CAUTION: DO NOT MOVE THE VEHICLE UNTIL A FIRM BRAKE PEDAL IS OBTAINED. AIR IN THE BRAKE SYSTEM CAN CAUSE LOSS OF BRAKES WITH POSSIBLE PERSONAL INJURY.

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

It may be necessary to bleed the hydraulic system at the front wheels if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If brake pipe is disconnected at any front wheel, then that wheel only need be bled. If pipes are disconnected at any fitting located between master cylinder and brakes, then the brake system served by the disconnected pipe must be bled.

IMPORTANT: Place keypad in LOCK mode.

1. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.
2. Fill the master cylinder reservoir with clean brake fluid. Keep reservoir at least half full during bleeding procedure.

NOTICE: Brake fluid is corrosive and will damage painted surfaces. Take care not to allow brake fluid to contact painted surfaces or electrical connectors. Clean shop cloths and clean containers should be used to prevent spillage of brake fluid.

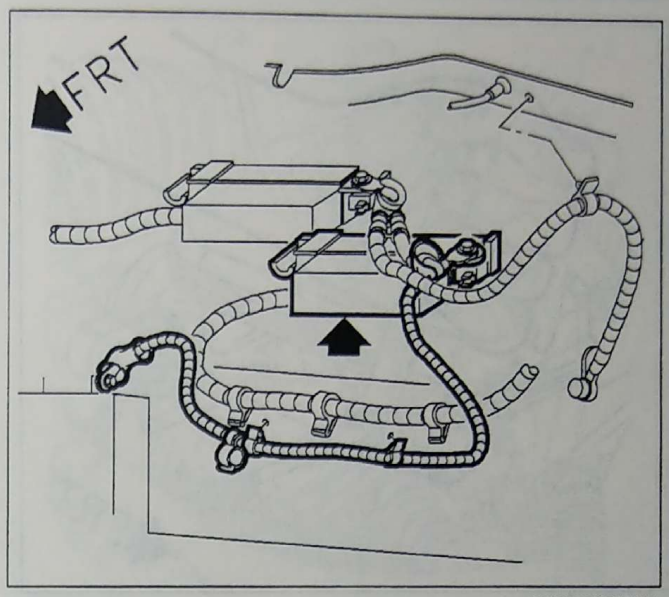
NOTICE: Use only Delco Supreme 11, DOT 3 brake fluid P/N 12377967 (or equivalent) from a clean sealed container. Do not use any brake fluid from a container which is wet, or may contain, oil, moisture, or other contaminants.

IMPORTANT: Be sure the master cylinder reservoir cap is installed before the brake pedal is pressed. This prevents brake fluid from spraying from the reservoir.

3. If the master cylinder is suspected of having air in its bore, it must be bled before proceeding to brake line bleeding.
   a. Loosen brake line fitting located at front of master cylinder.

IMPORTANT: Use the appropriate size line wrench when loosening or tightening brake line fittings.

   b. Allow brake fluid to flow from front master cylinder port.
   c. Tighten brake line fitting located at front of master cylinder.
   d. Loosen brake line fitting located at front of master cylinder 1/4 turn.



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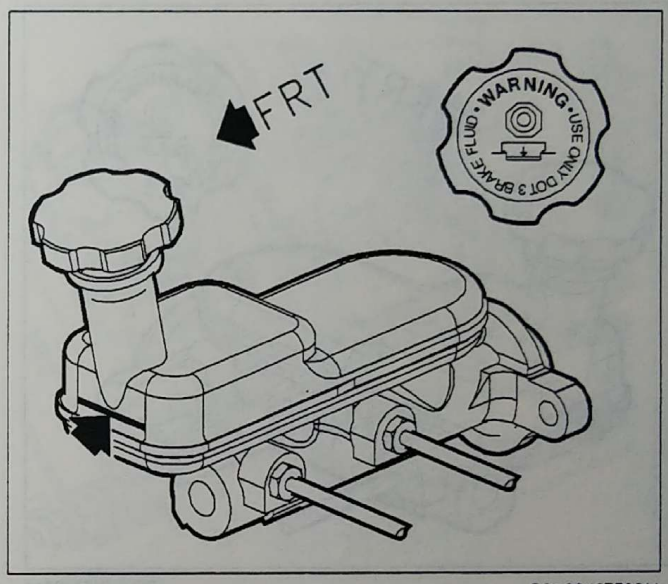

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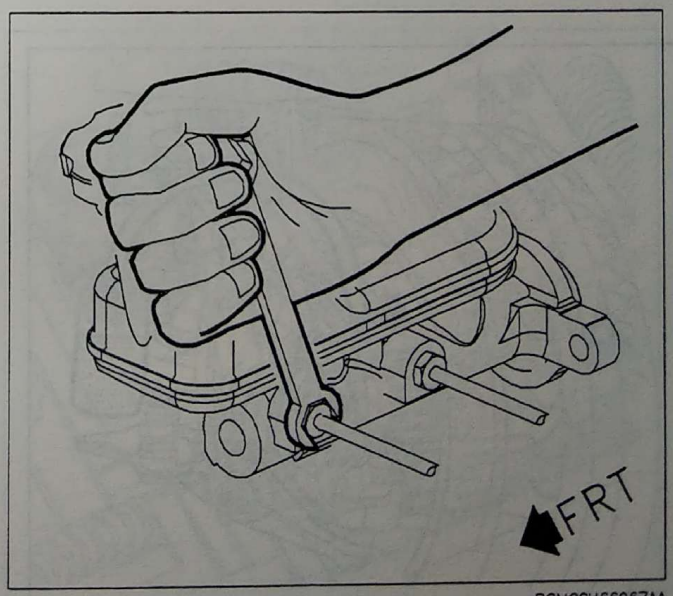

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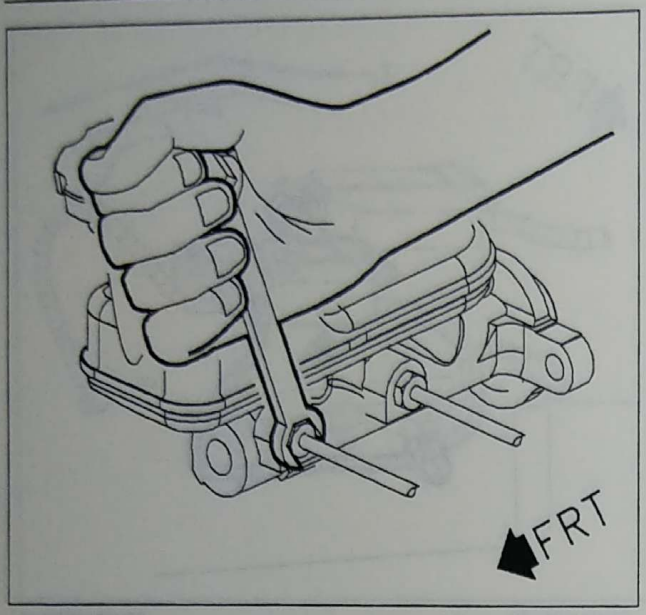

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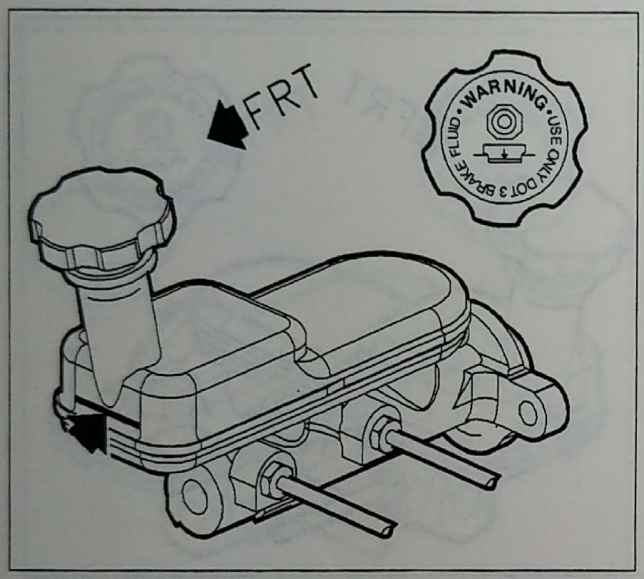

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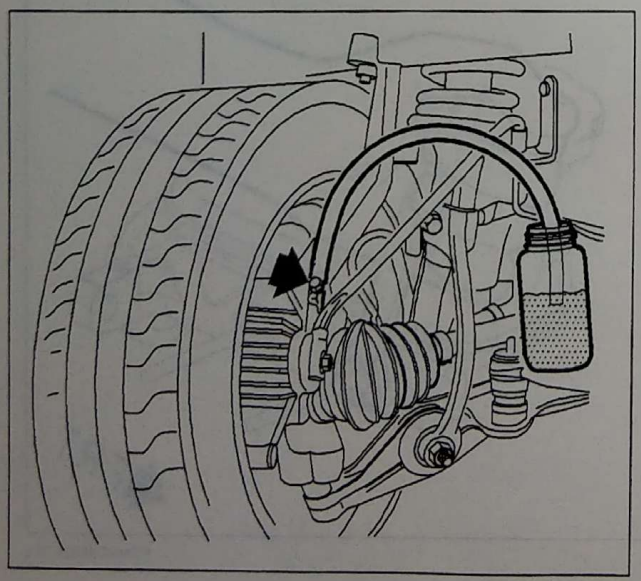

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e. Depress brake pedal **slowly** until brake fluid is seen coming from fitting.

f. Once again, tighten brake line fitting located at front of master cylinder while brake pedal is being depressed. **Slowly** release brake pedal.

Torque: 20 N•m (15 ft−lbs)

g. Repeat sequence until all air is removed from front of master cylinder bore.

IMPORTANT: Check and refill master cylinder reservoir as required to prevent air from being drawn through master cylinder.

h. Loosen brake line fitting located at rear of master cylinder.

i. Allow brake fluid to flow from rear master cylinder port.

j. Tighten brake line fitting located at rear of master cylinder.

k. Loosen brake line fitting located at rear of master cylinder.

l. Depress brake pedal **slowly** until brake fluid is seen coming from the rear brake line fitting.

m. Once again, tighten brake line fitting located at rear of master cylinder while brake pedal is being depressed. **Slowly** release brake pedal.

Torque: 20 N•m (15 ft−lbs)

n. Repeat sequence until all air is removed from rear of master cylinder.

4. Bleed individual front calipers.

IMPORTANT: To assist in freeing entrapped air, tap lightly on caliper casting with a rubber mallet.

a. Place the proper size box end wrench over caliper bleeder valve.

IMPORTANT: Check and refill master cylinder reservoir as required to prevent air from being drawn through master cylinder.

b. Attach transparent hose over caliper bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.

c. Open caliper bleeder screw 1/2 to 3/4 turn.

IMPORTANT: Make sure brake pedal is fully depressed. If brake pedal is not fully depressed, left front system may not bleed properly.

d. Apply brake pedal **slowly** and **hold**. Watch for air bubbles as the brake fluid leaves the bleeder hose.

e. Tighten caliper bleeder screw.

Torque: 11 N•m (97 in−lbs)

f. Release brake pedal

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g. Repeat sequence until all air is removed from brake line.

5. If more than one front caliper is being bled, bleed in the following sequence.
   a. Right front
   b. Left front

IMPORTANT: Check and refill master cylinder reservoir as required to prevent air from being drawn through master cylinder.

6. Check brake pedal feel for sponginess. If brake pedal exhibits this feel, repeat bleeding procedures if necessary.

   If brake pedal feel **is not** firm and constant or brake pedal travel is excessive after performing step 6:

   a. Remove power electronics bay (PEB). (Refer to "PEB Removal procedure" in the manual.)
   b. Attach transparent hose over #1 modulator bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.
   c. Open #1 modulator bleeder screw 1/2 to 3/4 turn and allow brake fluid to flow.

IMPORTANT: Make sure brake pedal is fully depressed. If brake pedal is not fully depressed, left front system may not bleed properly.

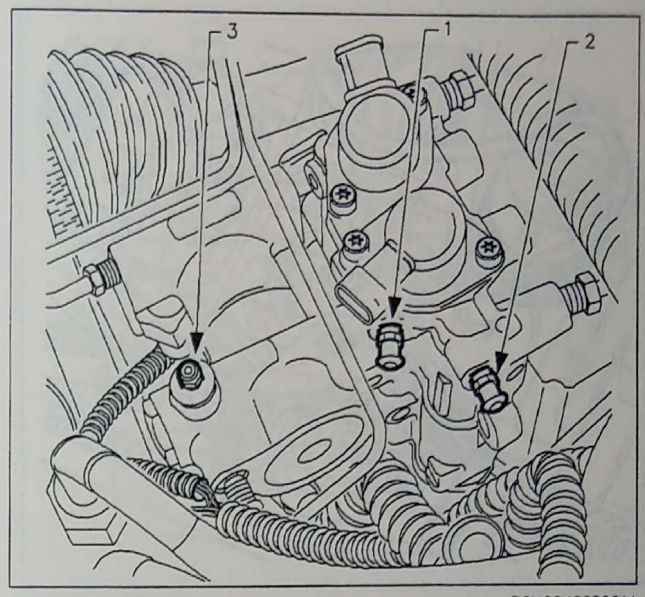
   d. Apply brake pedal **slowly** and **hold**. Watch for air bubbles as the brake fluid leaves the bleeder hose.
   e. Tighten #1 modulator bleeder screw.

Torque: 9 N•m (79.6 in−lbs)

   f. Release brake pedal.
   g. Repeat sequence until all air is removed from #1 modulator bleeder screw.
   h. Attach transparent hose over #2 modulator bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.
   i. Open #2 modulator bleeder screw 1/2 to 3/4 turn and allow brake fluid to flow.
   j. Apply brake pedal **slowly** and **hold**. Watch for air bubbles as the brake fluid leaves the bleeder hose.
   k. Tighten #2 modulator bleeder screw.

Torque: 9 N•m (79.6 in−lbs)

   l. Release brake pedal.
   m. Repeat sequence until all air is removed from #2 modulator bleeder screw.



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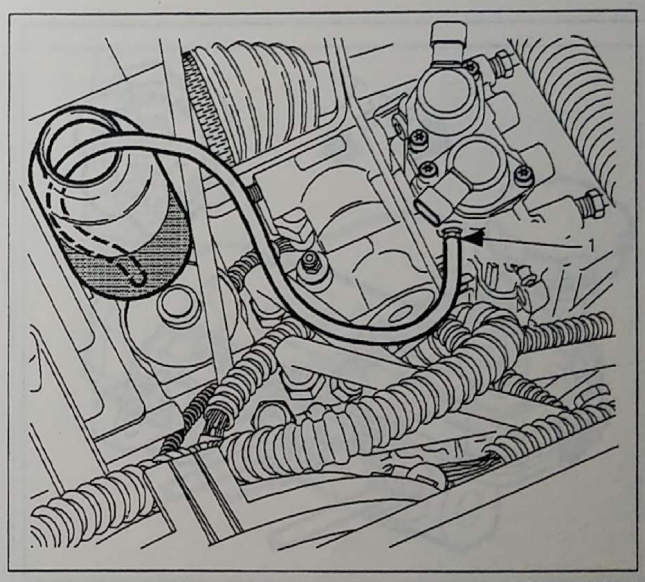

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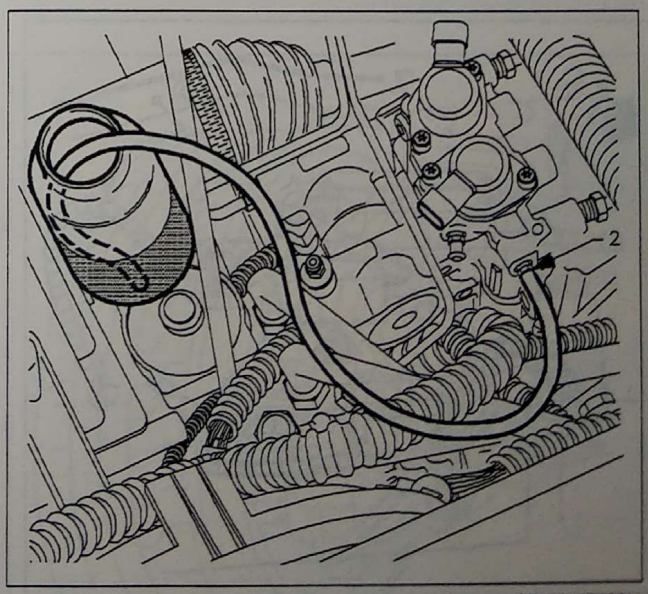

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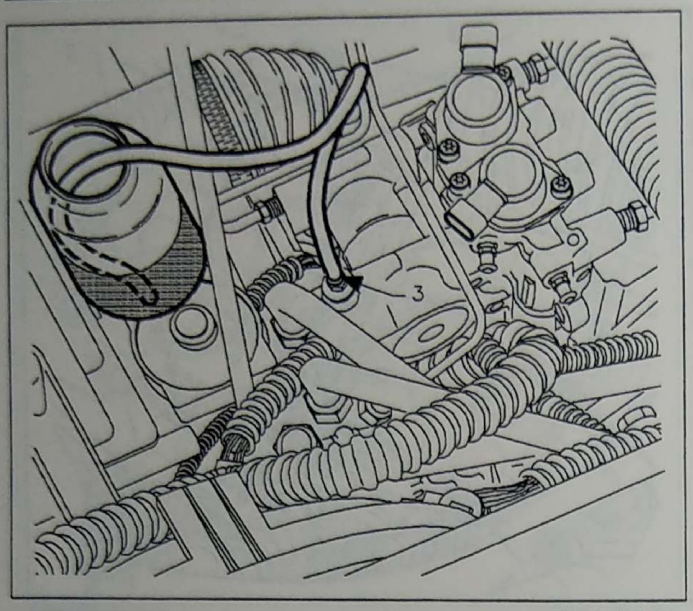

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n. Attach transparent hose over #3 emulator bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.

o. Open #3 emulator bleeder screw 1/2 to 3/4 turn and allow brake fluid to flow.

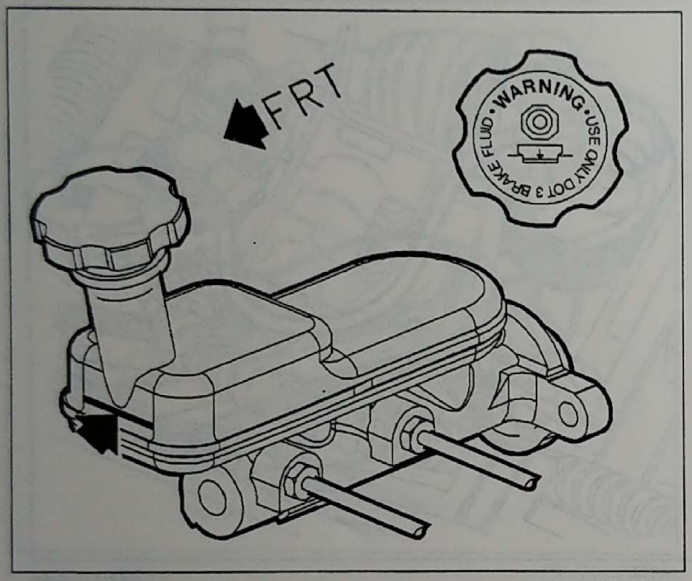
p. Apply brake pedal **slowly** and **hold**. Watch for air bubbles as the brake fluid leaves the bleeder hose.

q. Tighten #3 emulator bleeder screw.

Torque: 9 N•m (79.6 in−lbs)

r. Release brake pedal.

s. Repeat sequence until all air is removed from #3 emulator bleeder screw.



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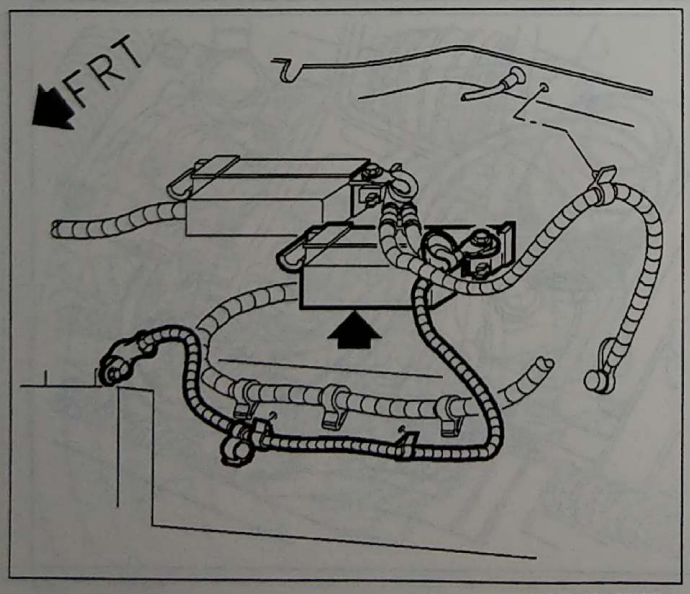
7. When bleeding procedure is completed, check the master cylinder reservoir brake fluid level. Fill as necessary and reinstall reservoir cap.
   - If brake pedal feel **is** firm and constant or travel **is not** excessive, go to step 8.
   - If brake pedal feel **is not** firm and constant or travel **is** excessive, repeat steps 2 thru 7.
8. Check brake system for leaks with brake applied.
9. If after inspection the brake pedal feels firm and constant and the pedal travel is not excessive, brake system is properly bled.



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10. Install TURN/MODULES maxi fuse into lower maxi fuse block located underhood between PEB and front of dash.
11. Install power electronics bay (PEB). (Refer to "PEB Installation procedure" in this manual.)

BRAKE SYSTEM BLEEDING

PRESSURE BLEEDING

NOTICE: Brake fluid is corrosive and will damage painted surfaces. Take care not to allow brake fluid to contact painted surfaces or electrical connectors. Clean shop cloths and clean containers should be used to prevent spillage of brake fluid.

NOTICE: Use only Delco Supreme 11, DOT 3 brake fluid P/N 12377967 (or equivalent) from a clean sealed container. Do not use any brake fluid from a container which is wet, or may contain, oil, moisture, or other contaminants.

NOTICE: Pressure bleeding equipment must be of the diaphragm type. It must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, and other contaminants from entering the hydraulic brake system.

IMPORTANT: Place keypad in LOCK mode.

1. Remove TURN/MODULES maxi fuse from lower Maxi fuse block located, underhood between PEB and front of dash.
2. Clean brake fluid reservoir cap and area around cap.
3. Remove brake fluid reservoir cap.
4. Fill the master cylinder reservoir with clean brake fluid.
5. Install bleeder adaptor (SA9150BR) or equivalent to the brake fluid reservoir.
6. Connect pressure bleeder to adapter.
7. Charge pressure bleeder equipment to 172−206 kPa (25−30 psi).

IMPORTANT: Do not depress brake pedal during pressure bleeding procedures. Applying brake will cause the solenoids to close and this will alter the ability to properly bleed front calipers.

8. Bleed front calipers.

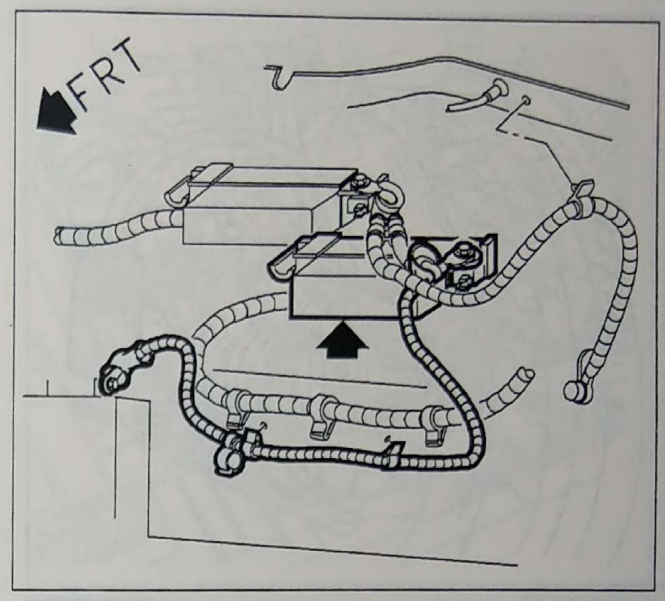
   Bleed in the following sequence.

   - Right front.
   - Left front.

   a. Place the proper size box end wrench over caliper bleeder valve.

   b. Attach transparent hose over caliper bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.

   c. Slowly open caliper bleeder screw 1/2 to 3/4 turn and allow fluid to flow until no air is seen in the brake fluid.



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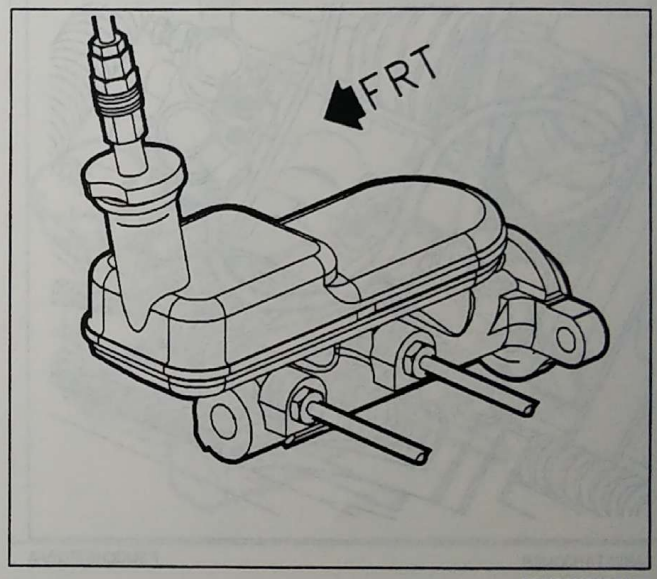

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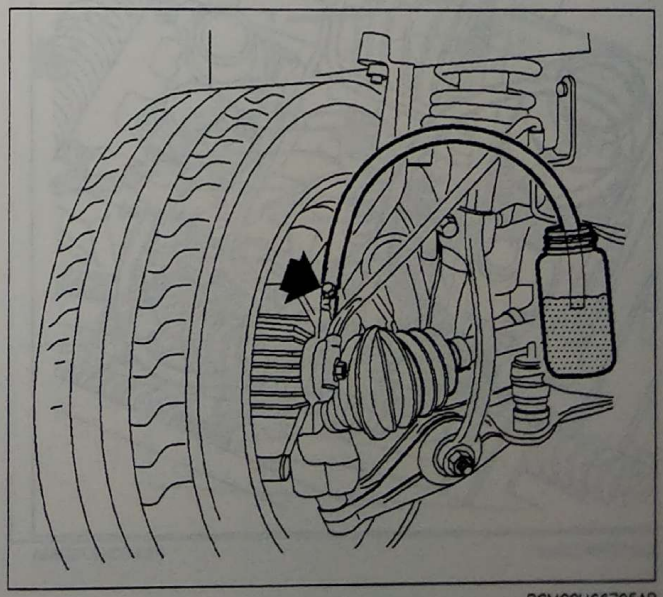

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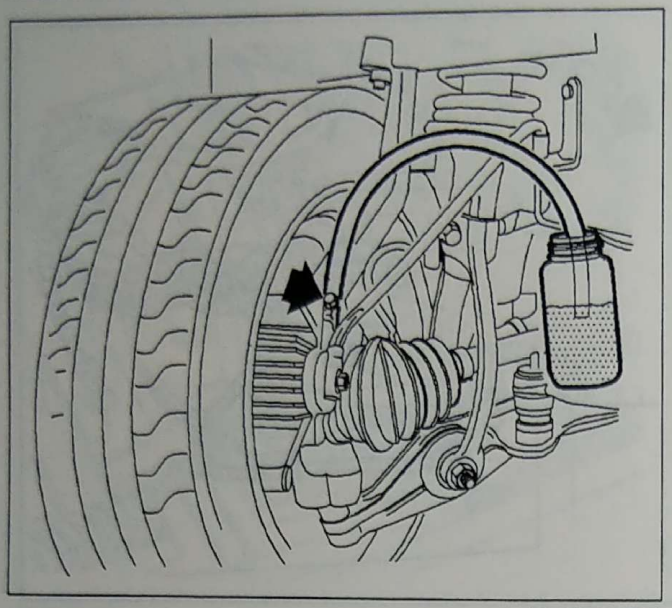

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d. Close the bleeder screw.

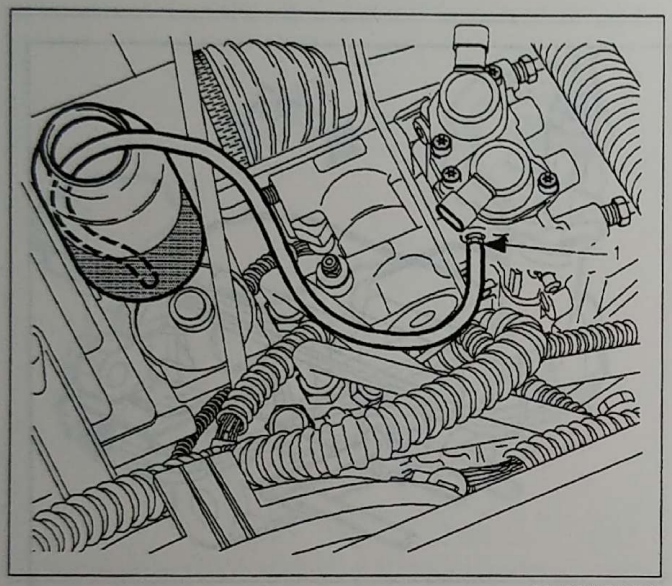
Torque: 11 N•m (97 in−lbs)

IMPORTANT: To assist in freeing entrapped air, tap lightly on caliper casting with a rubber mallet.

e. Repeat steps a thru d for each front caliper until no air is present.

9. If brake pedal feel **is not** firm and constant or brake pedal travel is excessive after performing step e:

a. Remove power electronics bay (PEB). (Refer to "PEB Removal" procedure in this manual.)



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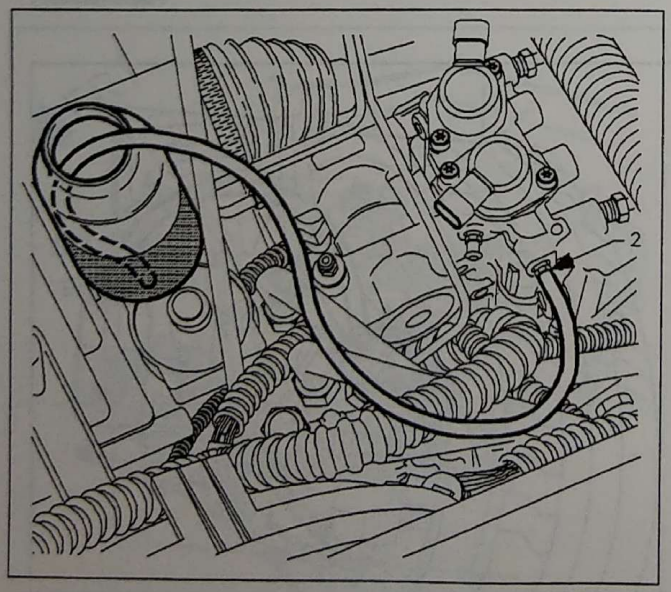
b. Attach transparent hose over #1 modulator bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.

c. Open #1 bleeder screw 1/2 to 3/4 turn and allow brake fluid to flow until no air is seen in the brake fluid.

d. Close #1 modulator bleeder screw.

Torque: 9 N•m (79.6 in−lbs)

e. Repeat sequence until all air is removed from #1 modulator bleeder screw.



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f. Attach transparent hose over #2 modulator bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.

g. Open #2 modulator bleeder screw 1/2 to 3/4 turn and allow brake fluid to flow until no air is seen in the brake fluid.

h. Close #2 modulator bleeder screw.

Torque: 9 N•m (79.6 in−lbs)

i. Repeat sequence until all air is removed from #2 modulator bleeder screw.

j. Attach transparent hose over #3 emulator bleeder valve nipple. Submerge other end of hose in a transparent container of brake fluid.

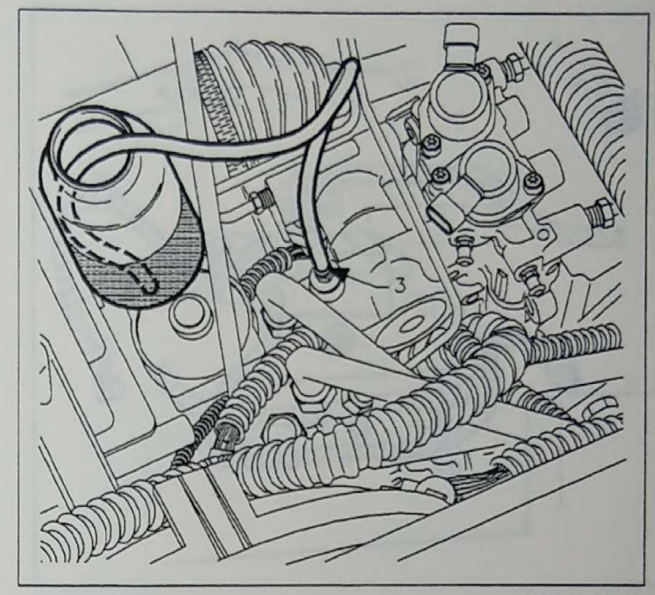
k. Open #3 emulator bleeder screw 1/2 to 3/4 turn and allow brake fluid to flow until no air is seen in the brake fluid.

l. Close #3 emulator bleeder screw.

Torque: 9 N•m (79.6 in–lbs)

m. Repeat sequence until all air is removed from #3 emulator bleeder screw.

10. Disconnect air pressure to bleeder.
11. Remove bleeder adapter.



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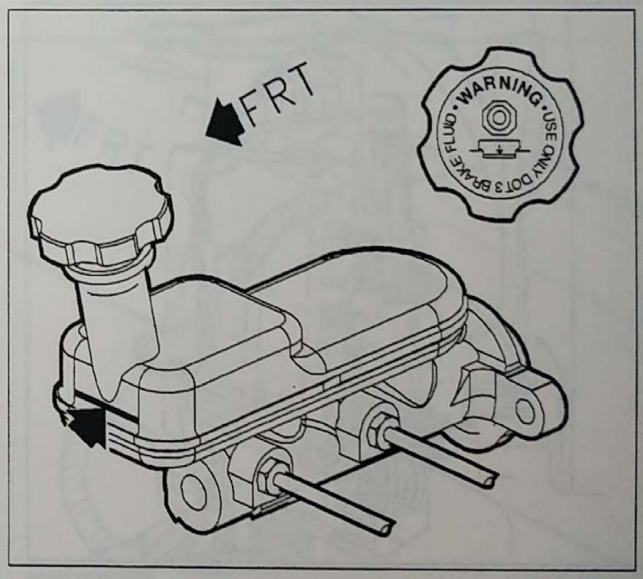
12. When bleeding procedure is completed, check the master cylinder reservoir brake fluid level. Fill as necessary and reinstall reservoir cap.
13. Install power electronics bay (PEB). (Refer to "PEB Installation" procedure in this manual.)



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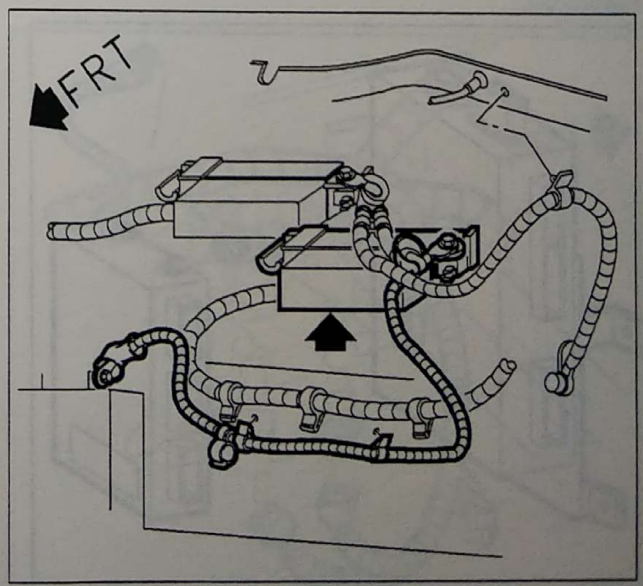
14. Install TURN/MODULES maxi fuse into lower maxi fuse block located underhood between PEB and front of dash.

IMPORTANT: Evaluate brake pedal feel with vehicle in the run mode. Vehicle must be in the run mode for at least 10 seconds.

15. If brake pedal feel **is** firm and constant and travel **is not** excessive, go to step 17.
16. If brake pedal feel **is not** firm and constant or travel **is** excessive, repeat steps 2 thru 12.
17. Check brake system for leaks with brake applied.
18. If after inspection the brake pedal feels firm and constant and the pedal travel is not excessive, brake system is properly bled.



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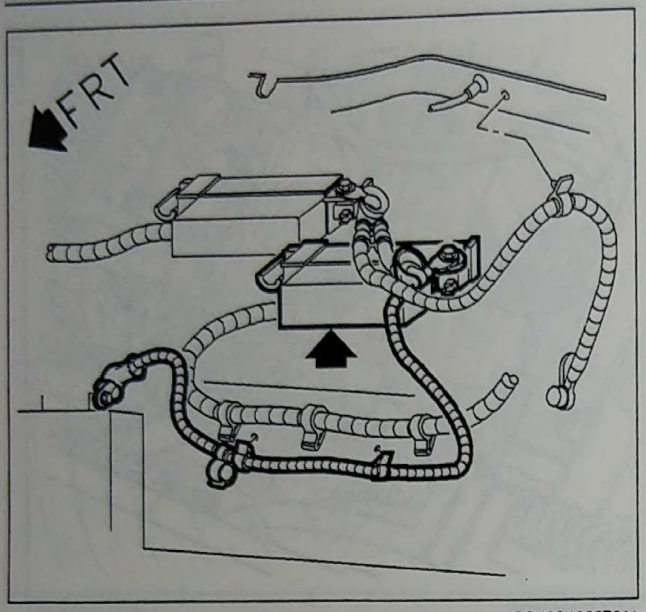

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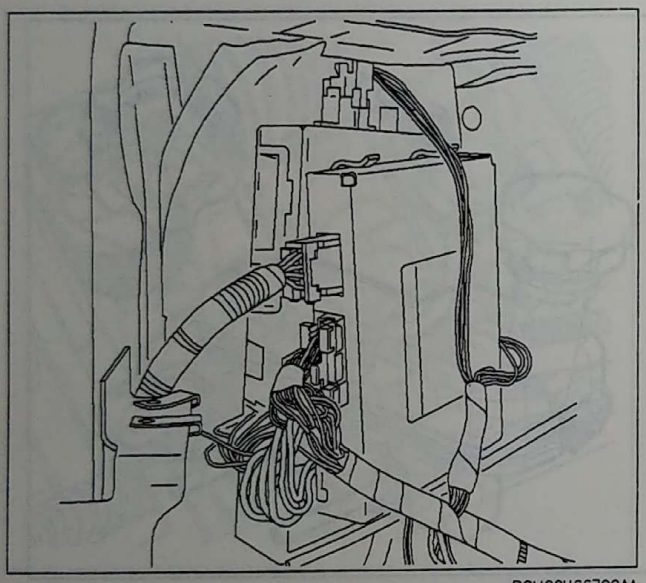

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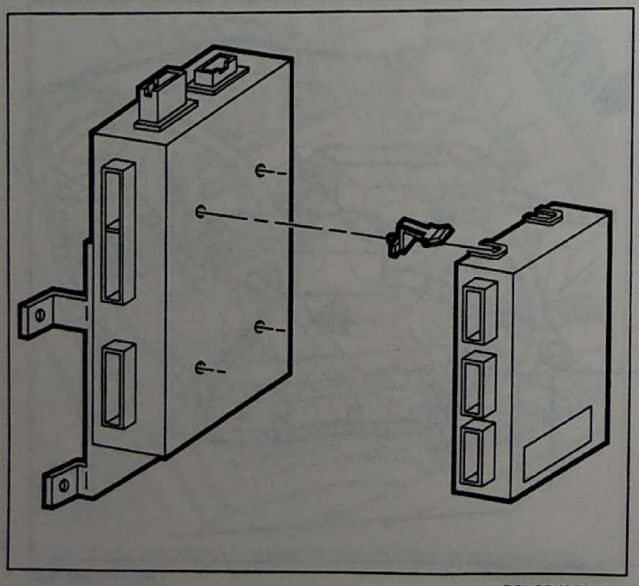

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BRAKE TORQUE CONTROL MODULE

REMOVAL

IMPORTANT: Place keypad in LOCK mode.

1. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.
2. Brake torque control module (BTCM) is attached to the left hand junction block (LHJB) with four retainers and is located under dash on the left (driver's) side of vehicle.

NOTICE: Do not pull on the connectors or wires to remove the BTCM. this could back out a terminal and cause an intermittent connection.

3. Release the four retainers securing BTCM to the LHJB and lift out.
4. Disconnect BTCM connectors.

INSTALLATION

1. Install the BTCM connectors.
2. Align retainers and push the BTCM into place.
3. Install Turn/Modules maxi fuse into lower maxi fuse block, located underhood between PEB and front of dash.

IMPORTANT: You must wait at least 30 seconds after restoring auxiliary battery power before powering up vehicle, or a BTCM DTC 115 may be set.

4. Reprogram the electrically erasable programmable read only memory (EEPROM) using the Saturn service stall system (SSS).

IMPORTANT: The BTCM contains an EEPROM that must be reprogrammed when a service replacement module is installed or a BTCM DTC 82 will be set.

VALVE ASSEMBLY BRAKE PRESSURE MODULATOR

REMOVAL

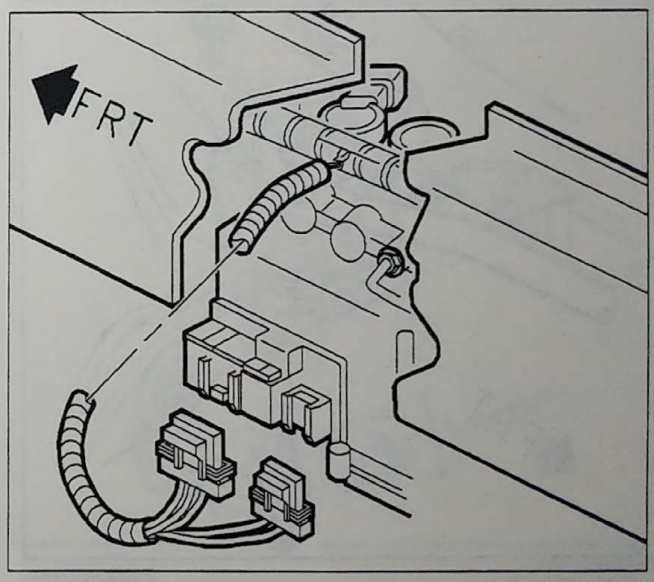
IMPORTANT: Place keypad in LOCK mode.

1. Remove the power electronics bay (PEB). (Refer to "PEB Removal and Installation" procedure in this manual.)

NOTICE: Prior to servicing the valve assembly brake pressure modulator be sure to clean all fittings at the valve, to ensure that no contaminants enter the brake system.

IMPORTANT: Place one shop cloth on top of the motor pack assembly and a second shop cloth below modulator to catch any dripping brake fluid.

2. Unseat lower portion of brake pressure modulator splash shield and position away from modulator.
3. Disconnect all electrical connectors from modulator assembly.
4. Disconnect brake line fitting nuts from modulator.



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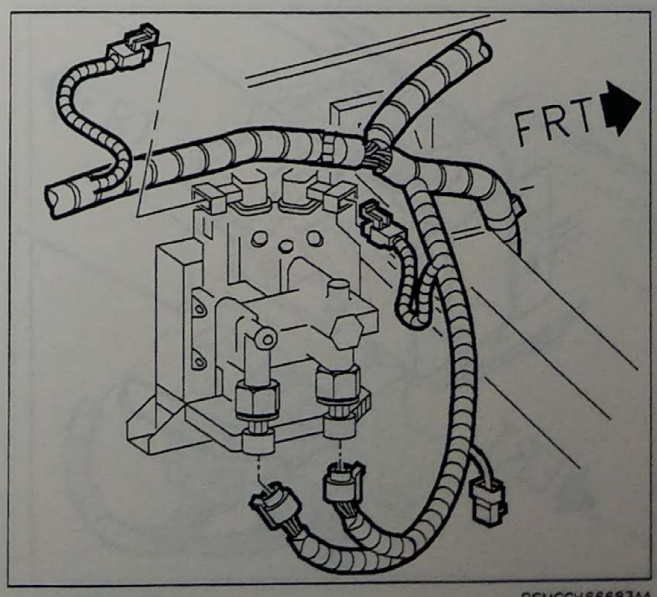

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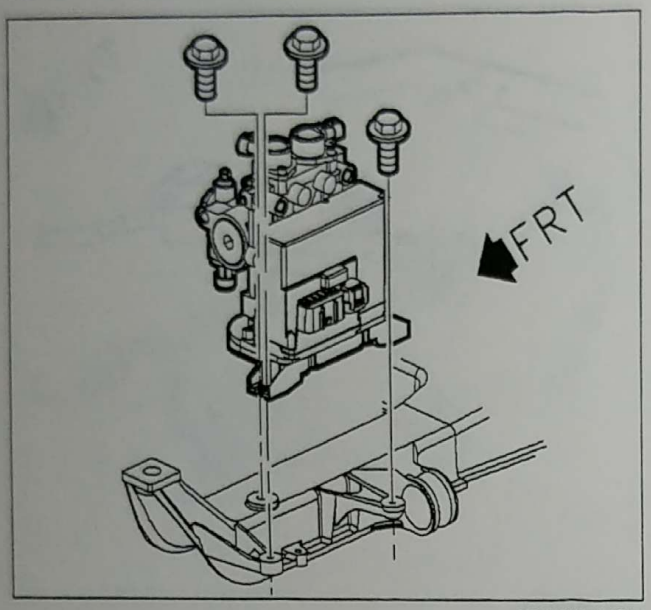

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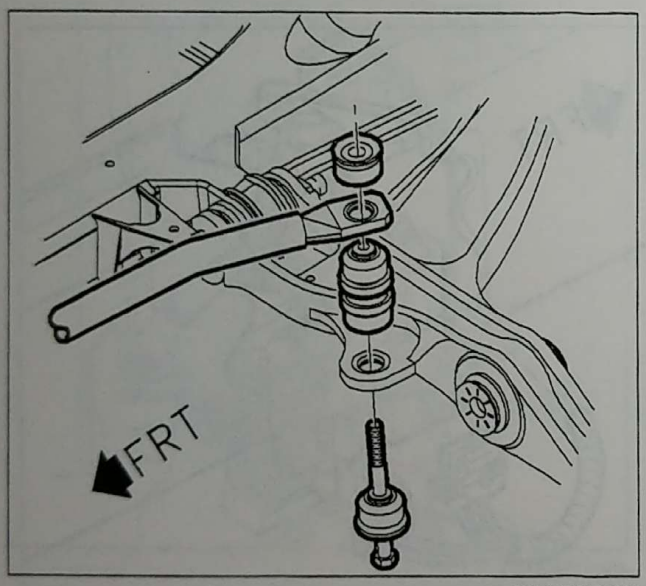
IMPORTANT: Use the appropriate size line wrench to loosen brake line fittings.

NOTICE: Plug open lines and fittings to prevent brake fluid loss and contamination

5. Remove fasteners securing modulator to cradle.
6. Raise the vehicle on a hoist. (Refer to the "Lifting, Jacking, Hoisting, and Support Points" section of this manual.)



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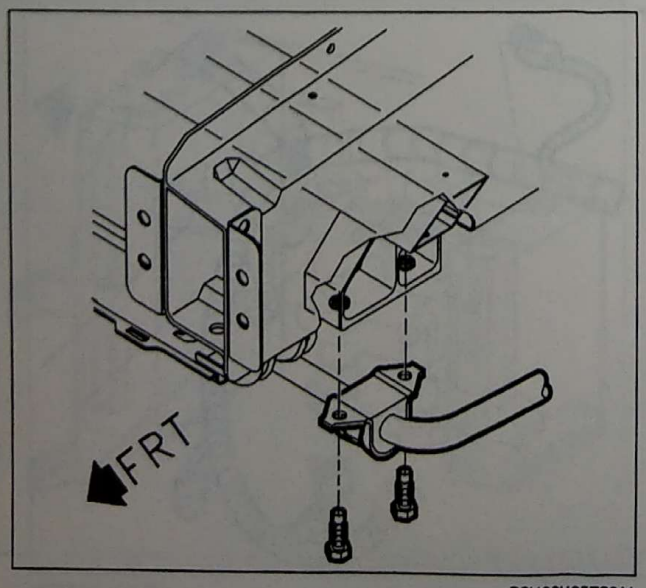
7. Disconnect front stabilizer links from lower control arms.
8. Remove clamp/insulator fasteners.
9. Remove front stabilizer from vehicle.
10. Remove splash shield from mid-rail.
11. Remove modulator assembly.

IMPORTANT: Be careful not to excessively bend brake lines during removal.

IMPORTANT: Be careful not to damage pressure sensors during removal of modulator assembly.



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INSTALLATION

1. Position valve assembly brake pressure modulator onto cradle and align mounting holes.

IMPORTANT: Be careful not to excessively bend brake lines during installation.

2. Install insulators and clamps onto stabilizer bar.

IMPORTANT: Split in insulator is to be oriented towards the front of vehicle.

3. Install stabilizer with insulators and clamps to body cross member and secure with fasteners.

Torque: 25 N•m (18 ft−lbs)

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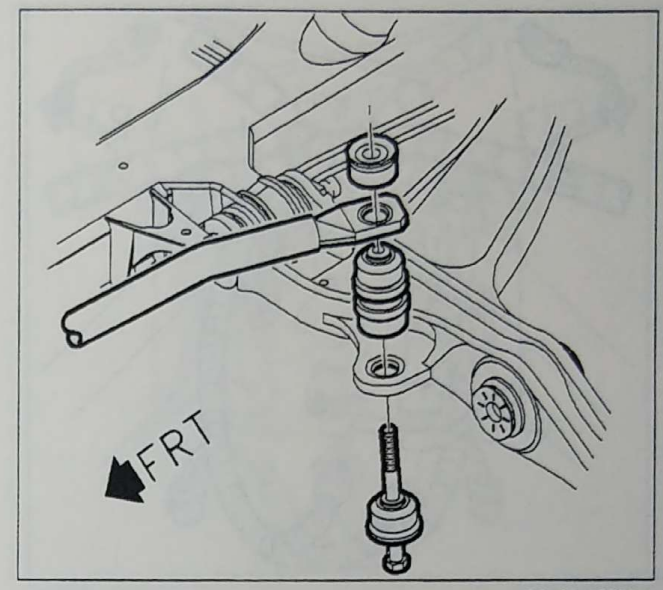
IMPORTANT: Orange paint mark must be located to the left side of vehicle.

4. Attach stabilizer bar to lower control arm links.

Torque: 10 N•m (89 in−lbs)

5. Lower vehicle.



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6. Install fasteners securing modulator onto cradle.

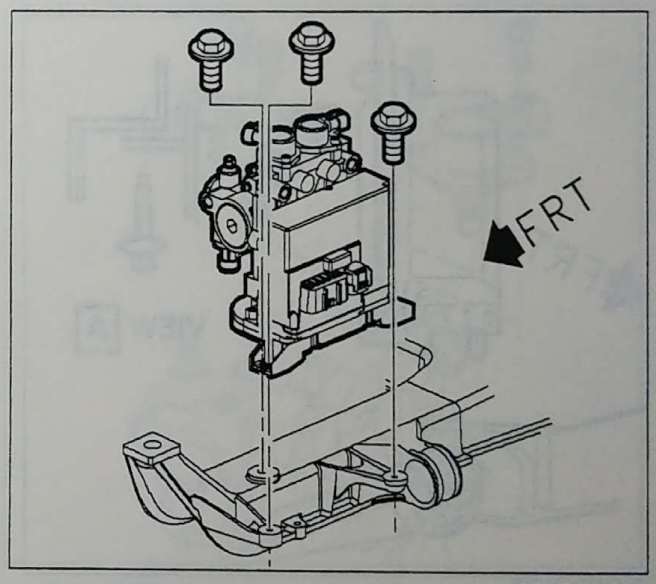
Torque: 13 N•m (115 in−lbs)

IMPORTANT: Make sure fasteners align properly with threaded holes in cradle. Use fingers to start threading fasteners into threaded holes in cradle.

7. Remove plugs from lines and fittings and position brake lines into modulator assembly and secure brake line fitting nuts.

Torque: 20 N•m (15 ft−lbs)

IMPORTANT: Use the appropriate size line wrench to torque brake line fittings.



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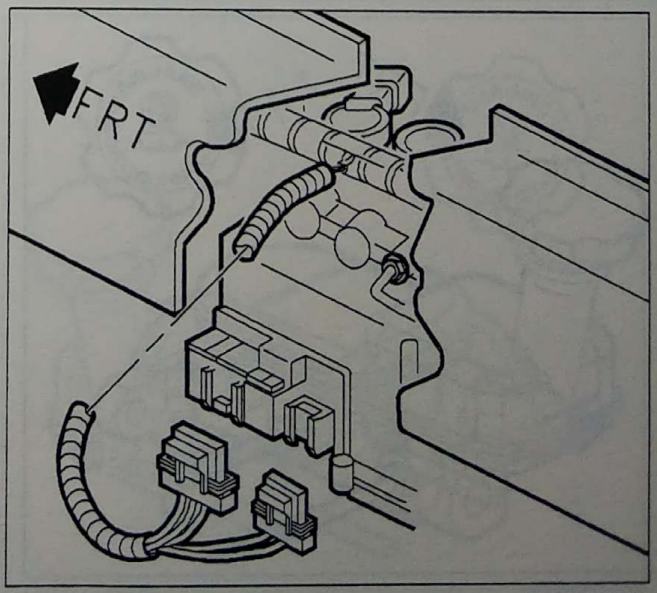
8. Connect all electrical connectors to modulator assembly.

IMPORTANT: Check to be sure that all electrical connectors are fully seated and latches are engaged.



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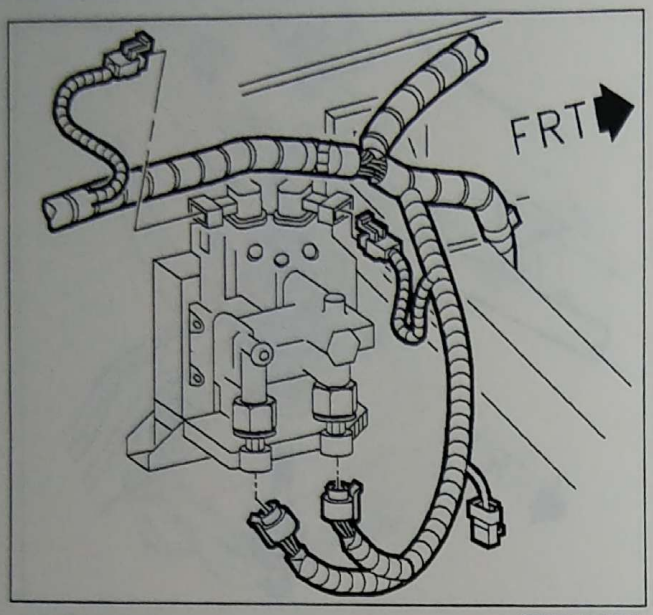

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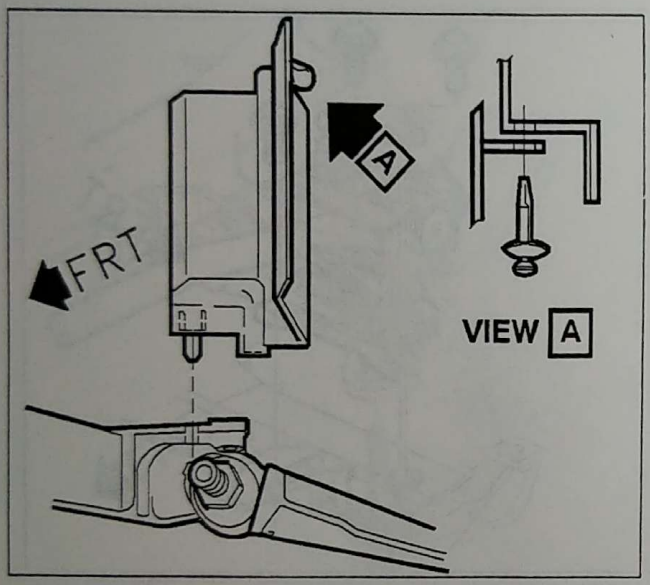

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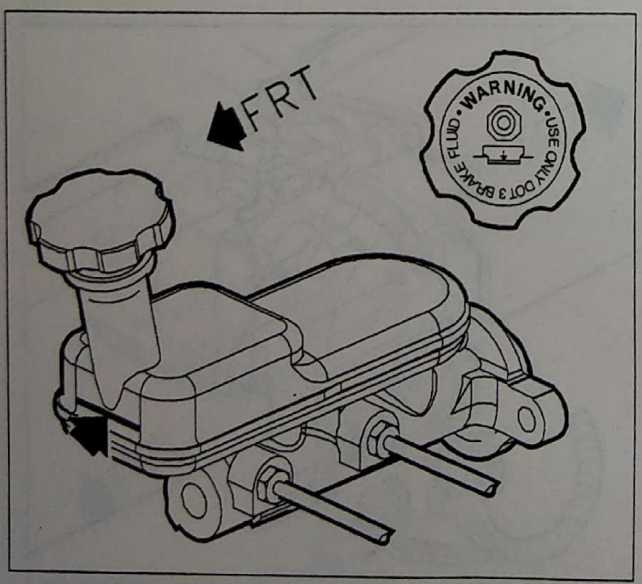
9. Install splash shield to left hand mid-rail using new fasteners.



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10. Check master cylinder reservoir brake fluid level.
11. Fill as necessary and install reservoir cap.
12. Bleed brake system (Refer to "Brake System Bleeding" in this service manual.)
13. Install the power electronics bay (PEB). (Refer to "PEB Removal and Installation" procedure in this manual.)

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BRAKE SOLENOID VALVE

REMOVAL

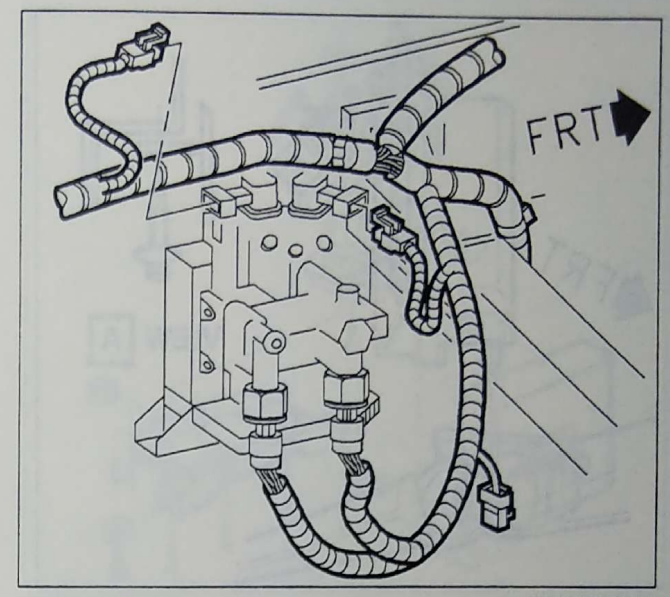
IMPORTANT: Place keypad in LOCK mode.

1. Remove power electronic Bay (PEB). (Refer to "PEB Removal" procedure in this manual.)
2. Clean dirt and other contamination from solenoid valve and area around solenoid.

IMPORTANT: The front solenoid (closest to front of vehicle) feeds the right front brake. The rear solenoid feeds the left front brake.

3. Remove electrical connector from solenoid valve.

IMPORTANT: Note the position of the solenoid electrical connector.



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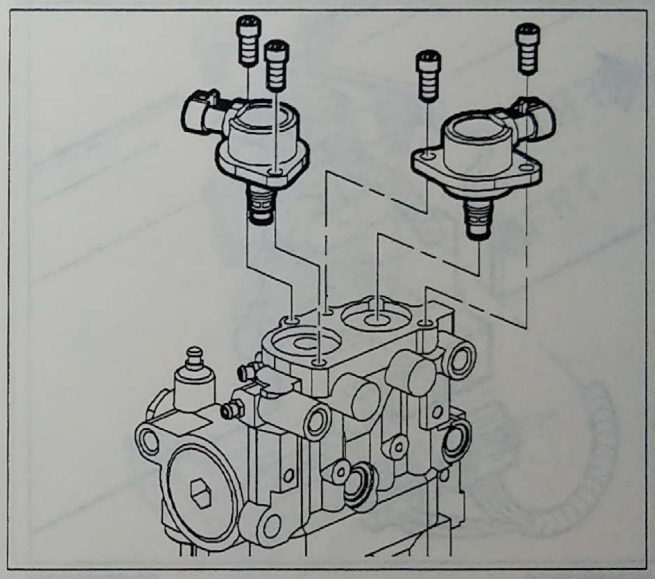
4. Remove two solenoid-to-modulator TORX™ head screws and remove solenoid valve from modulator.

IMPORTANT: Do not attempt to disassemble the solenoid; it is serviceable only as an assembly.



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INSTALLATION

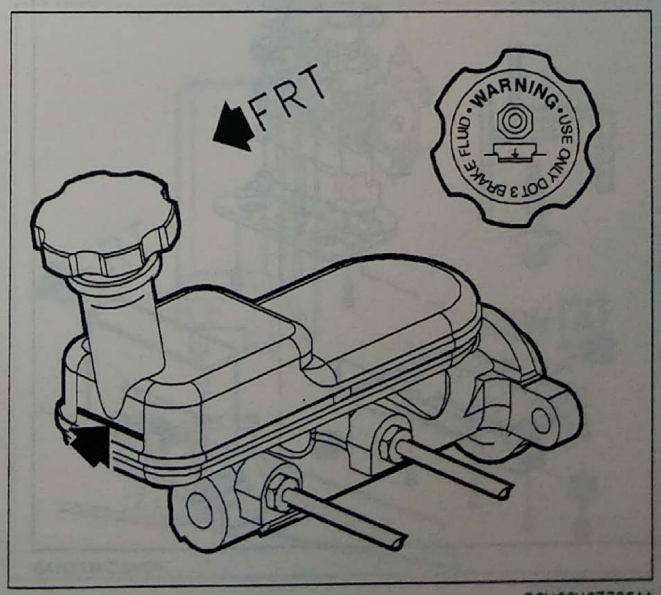
1. Lubricate solenoid O-ring seals with clean brake fluid.
2. Position solenoid valve into modulator. Push solenoid valve into the modulator until solenoid flange is fully seated.

IMPORTANT: Be sure solenoid electrical connector faces in the correct direction.

3. Install two solenoid-to-modulator TORX™ head screws.

Torque: 5 N•m (45 in−lbs)

4. Connect electrical connector to solenoid valve.
5. Check the master cylinder reservoir brake fluid level. Fill as necessary and install reservoir cap.
6. Bleed brake system (Refer to "Brake System Bleeding" in this manual.)
7. Install power electronic Bay (PEB). (Refer to "PEB Removal" procedure in this manual.)



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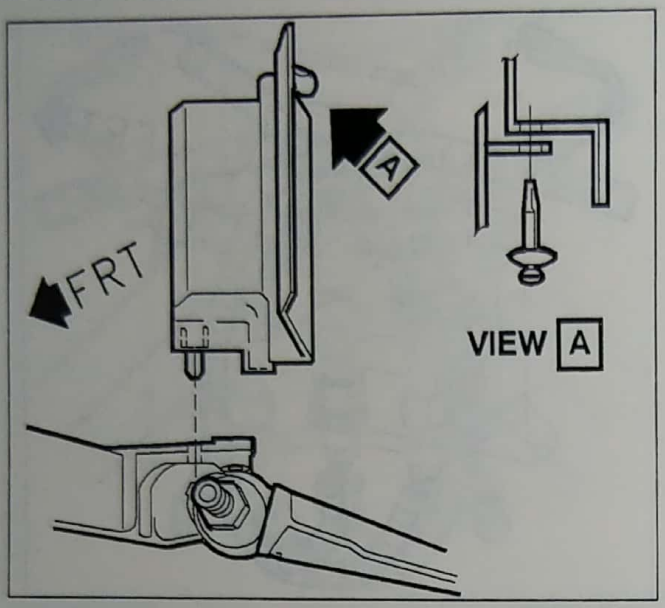

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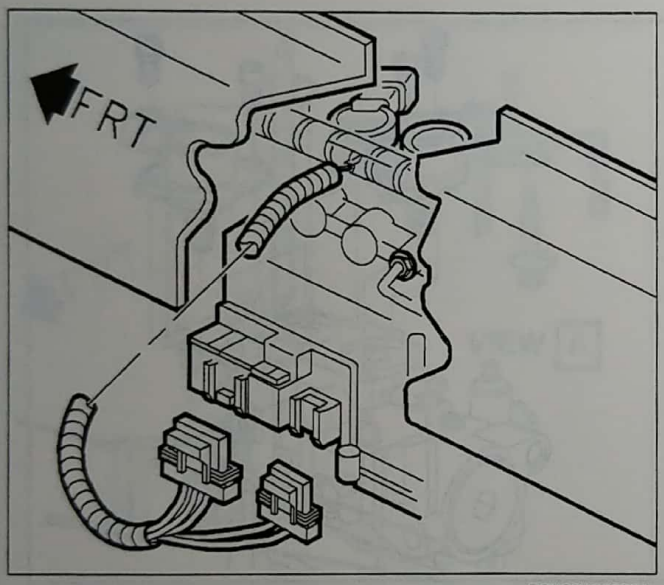

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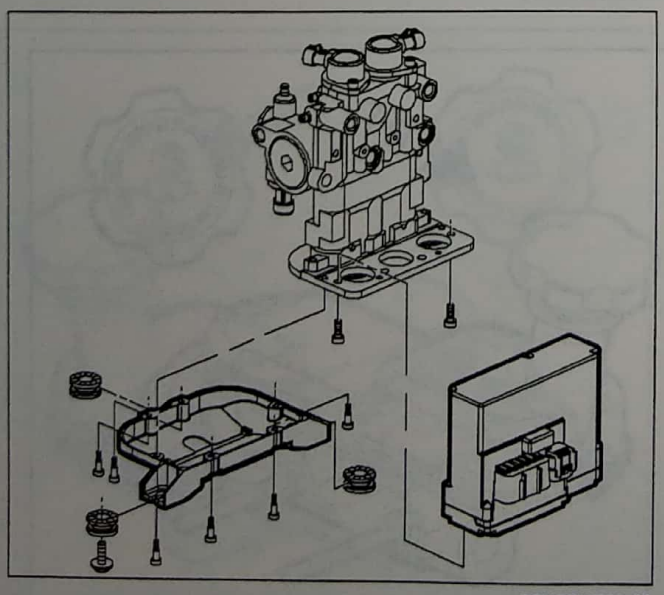

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MOTOR PACK, BRAKE PRESSURE MODULATOR VALVE

REMOVAL

IMPORTANT: Place keypad in LOCK mode.

IMPORTANT: Do not attempt to repair damaged motor packs. Repair of this assembly is not authorized. Do not lubricate or oil motor pack assembly.

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
2. Remove underbody front air deflector assembly (Refer to "Underbody Front Air Deflector Assembly" in this manual.)
3. Remove brake pressure modulator splash shield from mid-rail.
4. Disconnect electrical connectors from brake motor pack.

IMPORTANT: Be careful not to excessively bend brake lines or damage pressure sensors, when tilting modulator outwards.

5. Remove fasteners securing modulator to cradle.
6. Remove gear cover-to-modulator TORX™ head screws and separate gear cover from modulator.
7. Remove motor pack-to-modulator TORX™ head screws and separate motor pack from modulator.

INSTALLATION

1. With the modulator body over head, rotate each gear clockwise until movement stops. This procedure will position the pistons very close to the bottom of the modulator bore.

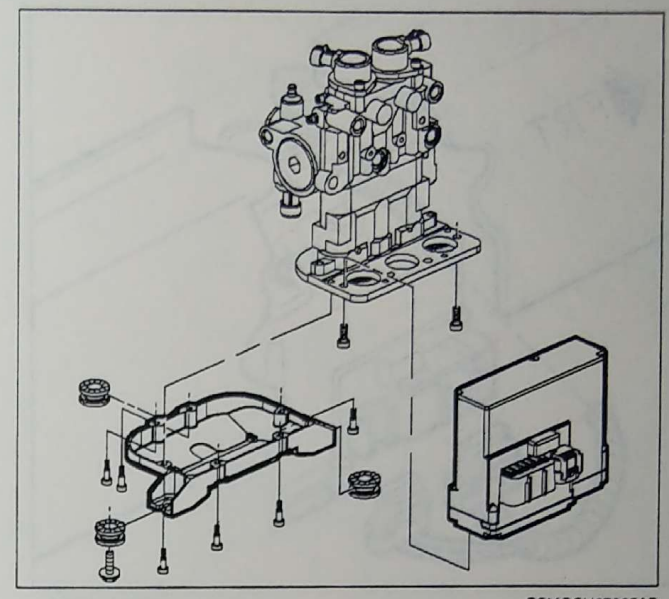
IMPORTANT: Note smoothness of operation. Movement should be smooth and steady. If roughness or irregular movement is experienced, replace brake pressure modulator valve.

2. Position motor pack onto modulator aligning the two motor pack gears with the modulator gears.
3. Install motor pack-to-modulator TORX™ head screws.

Torque: **4.5 N•m (40 in−lbs)**

4. Install gear cover onto modulator assembly.
5. Install gear cover-to-modulator TORX™ head screws.

Torque: 4.0 N•m (35 in−lbs)



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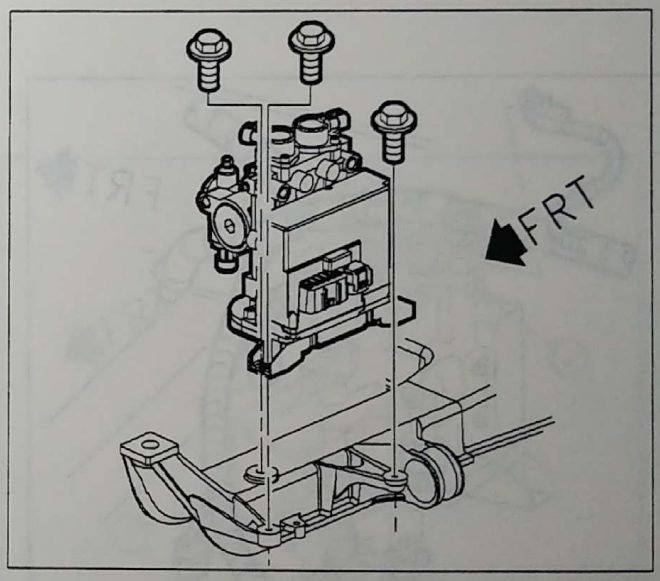
6. Install fasteners securing modulator to cradle.

Torque: 13 N•m (115 in−lbs)

IMPORTANT: Make sure fasteners align properly with threaded holes in cradle. Use fingers to start threading fasteners into threaded holes in cradle.



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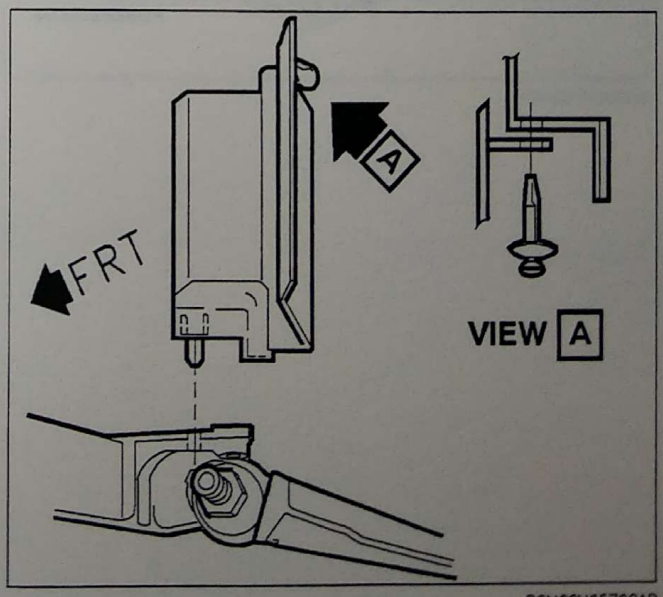
7. Install splash shield to left hand mid-rail using new fasteners.



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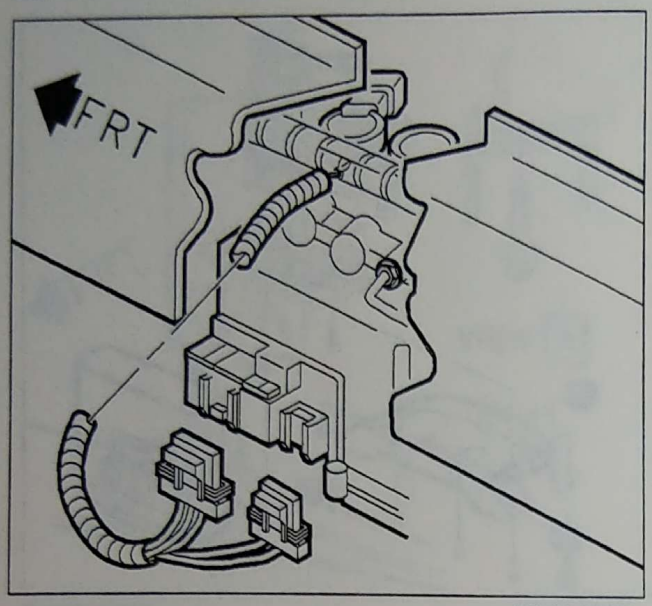

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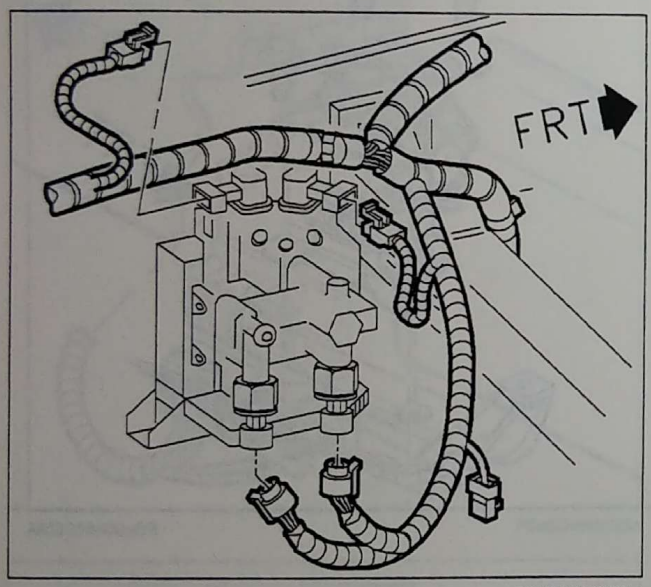

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8. Connect all electrical connectors to modulator assembly.

IMPORTANT: Check to be sure that electrical connectors are fully seated and latches are engaged.

9. Install underbody front air deflector assembly (Refer to "Underbody Front Air Deflector Assembly" in this manual.)

Torque: 6 N•m (53 in−lbs)

10. Lower vehicle from hoist.

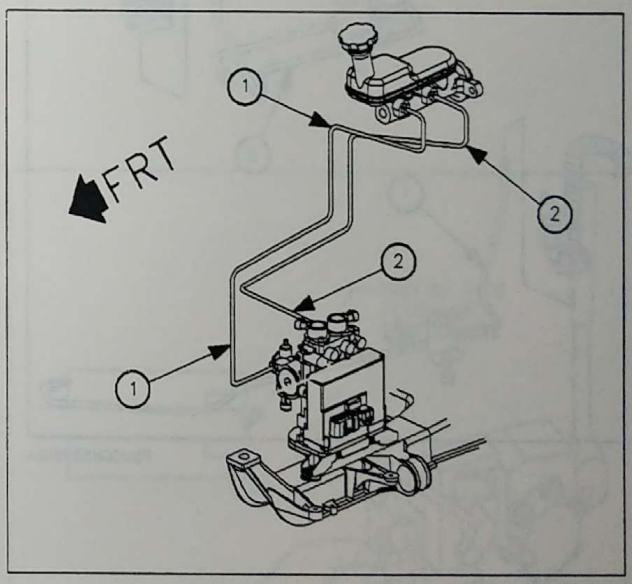
BRAKE PIPE REPLACEMENT

ISO/DIN FLARE

CAUTION: ALWAYS USE DOUBLE WALLED STEEL BRAKE PIPE WHEN REPLACING BRAKE PIPES. NEVER USE COPPER TUBING BECAUSE COPPER IS SUBJECT TO FATIGUE, CRACKING AND CORROSION WHICH COULD RESULT IN BRAKE FAILURE. THE USE OF ANY OTHER PIPE IS NOT RECOMMENDED AND MAY CAUSE BRAKE SYSTEM FAILURE. CAREFULLY ROUTE AND RETAIN REPLACEMENT BRAKE PIPES. ALWAYS USE THE CORRECT FASTENERS AND THE ORIGINAL LOCATION FOR REPLACEMENT BRAKE PIPES. FAILURE TO PROPERLY ROUTE AND RETAIN BRAKE PIPES MAY CAUSE DAMAGE TO THE BRAKE PIPES AND CAUSE BRAKE SYSTEM FAILURE.

NOTICE: Original equipment brake pipes have a coating applied to both the brake pipes as well as the nuts. This coating provides added protection against corrosion. If possible replace brake pipes and nuts with original equipment parts. Original equipment brake pipes and nuts are available through service parts.

CHART 1			
Brake Pipes to Master Cylinder			
Ref. No.	Circuit	Nut Size	Torque
1	M/C, FRT to MOD,FRT, INBOARD	M12 x 1.0, 14 hex M10 x 1.0, 12 hex	20 N•m (15 ft−lbs)
2	M/C, REAR to MOD., REAR, INBOARD	M11 x 1.5, 14 hex M10 x 1.0, 12 hex	



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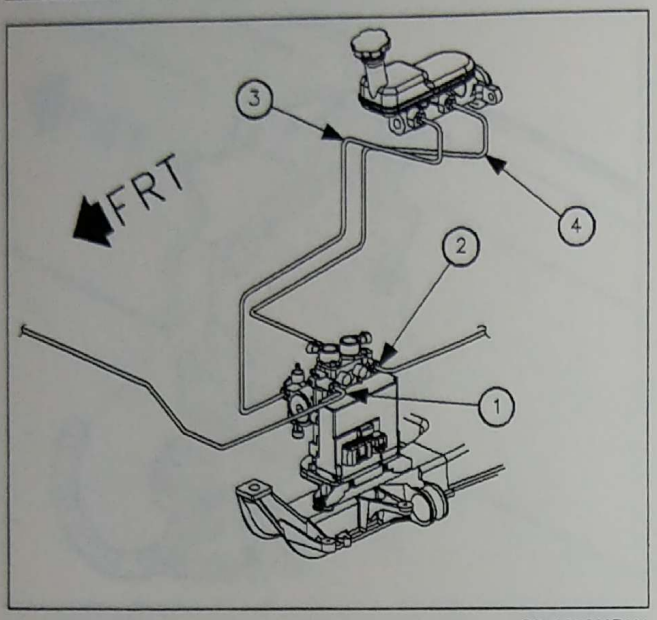

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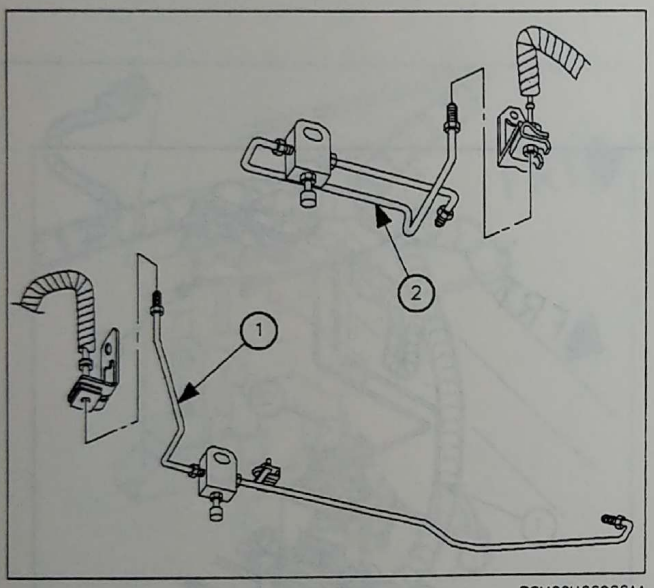

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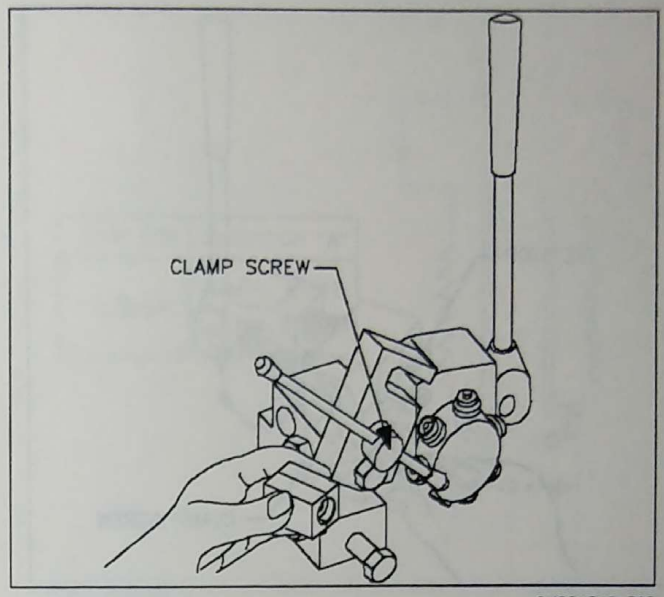
CHART 2
Brake Pipes to Modulator

Ref. No.	Circuit	Nut Size	Torque
1	MOD, FRT, OUT-BOARD to SENSOR TEE, RH	M10 x 1.0, 12 hex M10 x 1.0, 12 hex	20 N•m (15 ft–lbs)
2	MOD, REAR, OUT-BOARD to SENSOR TEE, LH	M11 x 1.5, 14 hex M10 x 1.0, 12 hex	
3	MOD, FRT, INBOARD to M/C, FRT	M10 x 1.0, 12 hex M12 x 1.0, 14 hex	
4	MOD, REAR, INBOARD to M/C, REAR	M10 x 1.0, 12 hex M11 x 1.5, 14 hex	

CHART 3
Brake Tee's to Hose

Ref. No.	Circuit	Nut Size	Torque
1	TEE, RH to RH, FRT HOSE	M10 x 1.0, 12 hex M10 x 1.0, 12 hex	20 N•m (15 ft–lbs)
2	TEE, LH to LH, FRT HOSE	M10 x 1.0, 12 hex M10 x 1.0, 12 hex	20 N•m (15 ft–lbs)

1. Obtain recommended pipe and fittings of correct size. Outside diameter of pipe is used to specify size. The EV1 uses 4.75 mm (0.187 in.) brake pipe.
2. Remove brake pipe to be repaired from vehicle.
3. Cut brake pipe to length. The end of the brake pipe must be flat and square to produce a good flare.
4. Determine the length of pipe required for the repair by measuring the section to be replaced with a string adding 3.2 mm (1/8 in.) for each flare.
5. Cut brake pipe to length. The end of the brake pipe must be flat and square to produce a good flare.
6. Remove burrs from the inside and outside diameters of the cut pipe using a de-burring tool.
7. Clean out brake pipe by using shop air to blow-out any metal chips and or contamination.
8. Install required fittings.
9. Clamp brake pipe flaring tool SA9193BR (or equivalent) securely in a vice.
10. Install handle into operating cam.
11. Loosen die clamp screw and rotate locking plate to expose die carrier opening.
12. Select required die set (**4.75 mm DIN**) and install in carrier with full side of either half facing clamp screw and counter bore of both halves facing punch turret.
13. Insert prepared pipe through rear of die and push forward until the end of pipe is flush with face of die.



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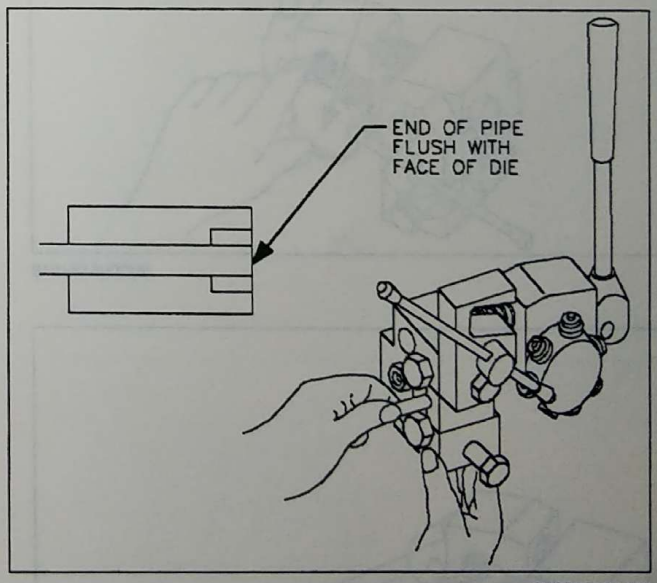

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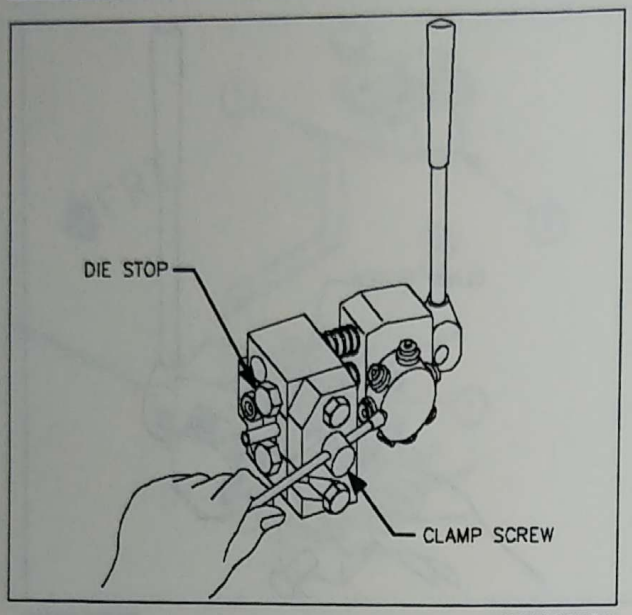

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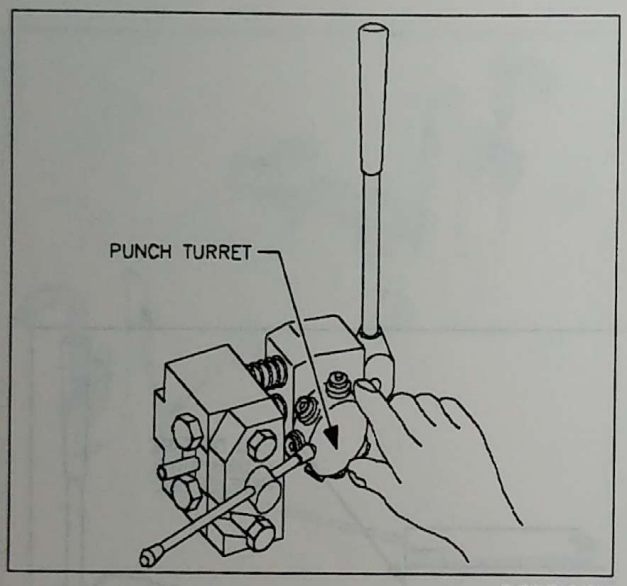
14. Make sure that the rear of both halves of the die rest against hexagon die stops. Rotate locking plate to the fully closed position and clamp die firmly by tightening clamp screw.



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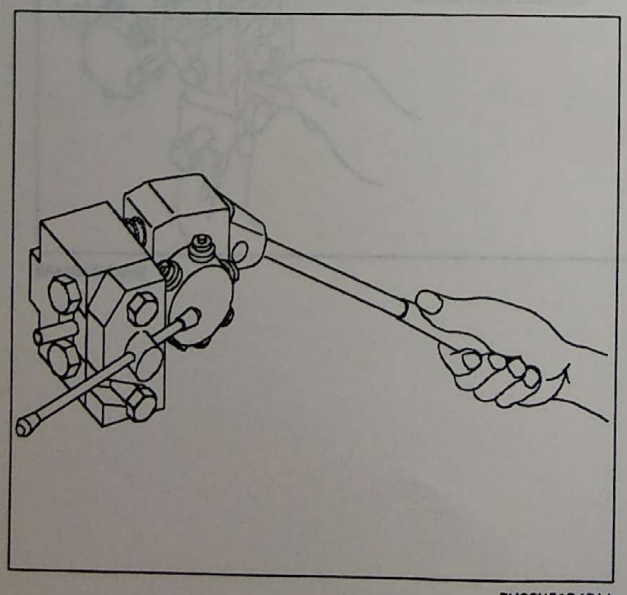
15. Select appropriate OP. 1 (operation 1) punch by rotating punch turret until the correct size (**4.75 mm DIN**) points towards the open end of the pipe to be flared.



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16. Pull the operating handle against the resistance of the pipe to create the flare and return handle to original position.
17. Release clamp screw and rotate locking plate to the open position.
18. Remove the die set and pipe and separate by gently tapping both halves on a bench.

19. Inspect pipe flare for correct shape, size and any flaws.
20. Clean out brake pipe by using shop air to blow-out any metal chips and or contamination.
21. Repeat procedure (steps 6 thru 20) for pipe being repaired.
22. Bend pipe using an approved pipe bending tool such as SA91108NE (or equivalent), using the section to be replaced as a guide.
23. Install new pipe to pipe being repaired using female union.

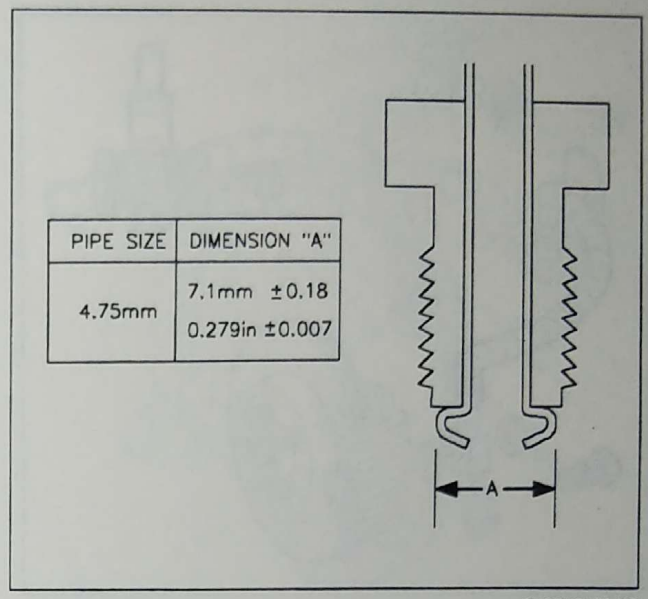
Torque: 20 N•m (15 ft-lbs)

24. Install repaired pipe assembly into vehicle.

Torque: 20 N•m (15 ft-lbs)

25. Bleed brake system. (Refer to "Brake Bleeding" procedure in this manual.)
26. Check pipes and fitting for leaks with brakes applied.

PIPE SIZE	DIMENSION "A"
4.75mm	7.1mm ±0.18 0.279in ±0.007



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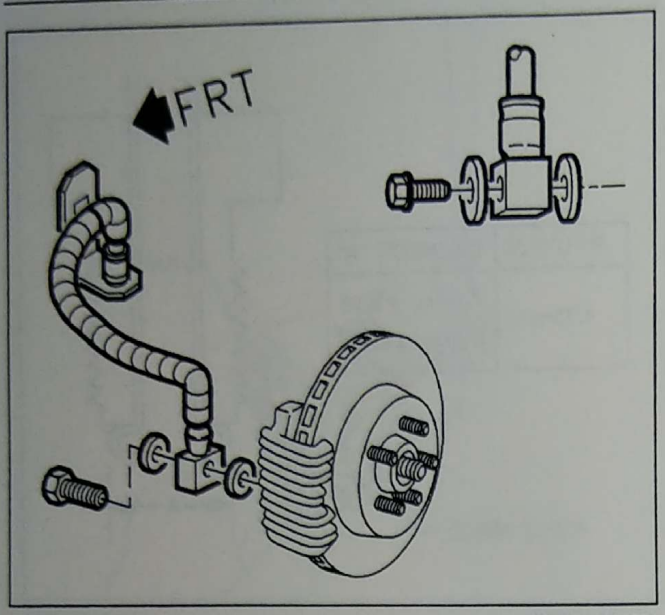

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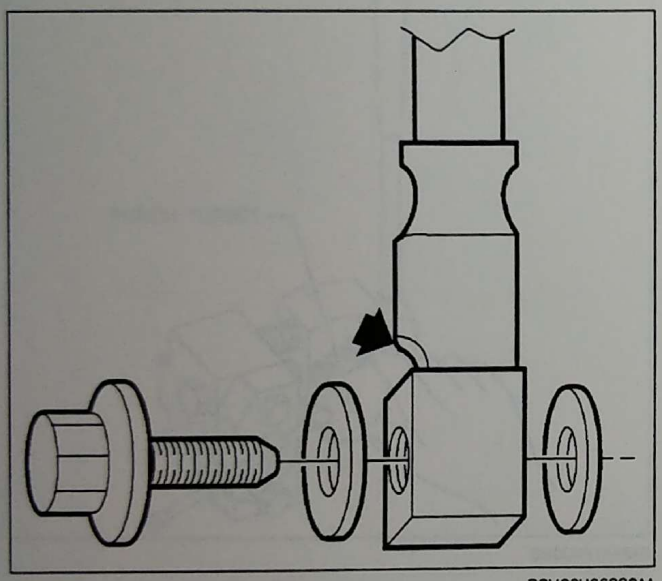

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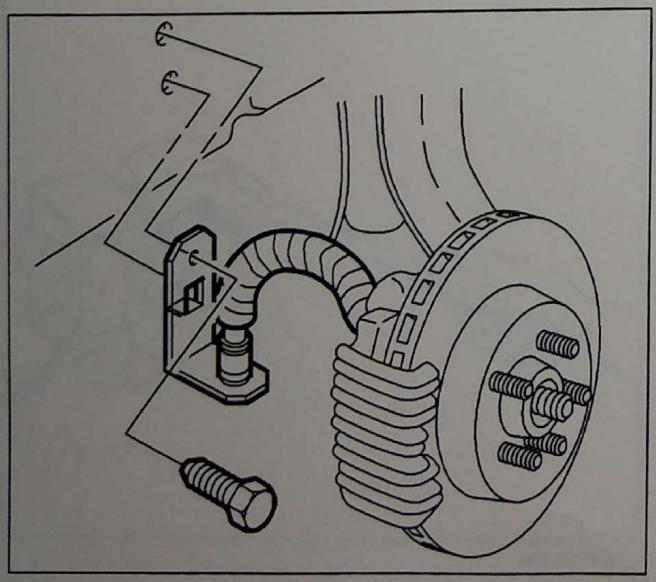

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BRAKE HOSE

REMOVAL

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
2. Remove road wheel.
3. Disconnect brake hose from front caliper. Plug opening in caliper to avoid brake fluid loss and contamination.
4. Disconnect brake hose from brake pipe. Plug opening in pipe to avoid fluid loss and contamination.
5. Remove fastener securing brake hose bracket.

IMPORTANT: When disconnecting or connecting brake hose from brake pipe, secure hose and bracket using a 5/8 inch wrench across brake hose fitting flats.

INSTALLATION

1. Install fastener securing brake hose bracket.

Torque: 10 N•m (89 in−lbs)

2. Install brake hose to brake pipe.

Torque: 20 N•m (15 ft−lbs)

IMPORTANT: Be sure that the front brake hose is routed correctly.

3. Install brake hose to caliper with **new** gaskets.

NOTICE: Attach brake hose to caliper with notch in hose fitting facing toward fastener, see illustration.

Torque: 40 N•m (29 in−lbs)

4. Bleed brake system. (Refer to "Brake Bleeding" procedure in this manual.)
5. Check connections for fluid leaks.

NOTICE: Before installing wheels, remove rust or corrosion from wheel mounting surfaces and brake rotors. Failure to do so can cause wheel lug nuts to loosen in service.

6. Position wheel onto hub.
7. Install wheel lug nuts and tighten in a star pattern. Repeat tightening pattern to be sure torque is correct.

Torque: 120 N•m (89 in−lbs)

8. Lower vehicle from hoist.

CamScanner

BRAKE PRESSURE SENSOR UPSTREAM (MODULATOR)

REMOVAL

IMPORTANT: Place keypad in LOCK mode.

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
2. Remove underbody front air deflector assembly. (Refer to "Underbody Front Air Deflector Assembly" in this manual.)
3. Locate brake pressure sensors attached to valve assembly brake pressure modulator, inboard.
4. Remove electrical connector from brake pressure sensor.

IMPORTANT: Brake pressure sensors are very fragile. Handle with care.

NOTICE: Prior to servicing the pressure sensor, be sure to clean pressure sensor and modulator assembly to ensure that no contaminants enter the brake system.

5. Loosen brake pressure sensor to be removed using a 1 1/16 in crowsfoot and universal joint.

IMPORTANT: Use a shop cloth wrapped around the pressure sensor to catch any dripping brake fluid.

6. Remove sensor by hand.

NOTICE: Brake fluid is corrosive and will damage painted surfaces. Take care not to allow brake fluid to contact painted surfaces or electrical connectors. Clean shop cloths and clean containers should be used in case of spillage of brake fluid.

INSTALLATION

NOTICE: O-ring material is special. Only use original equipment O-ring. A new O-ring must be installed anytime pressure sensor is removed. do not lubricate O-ring.

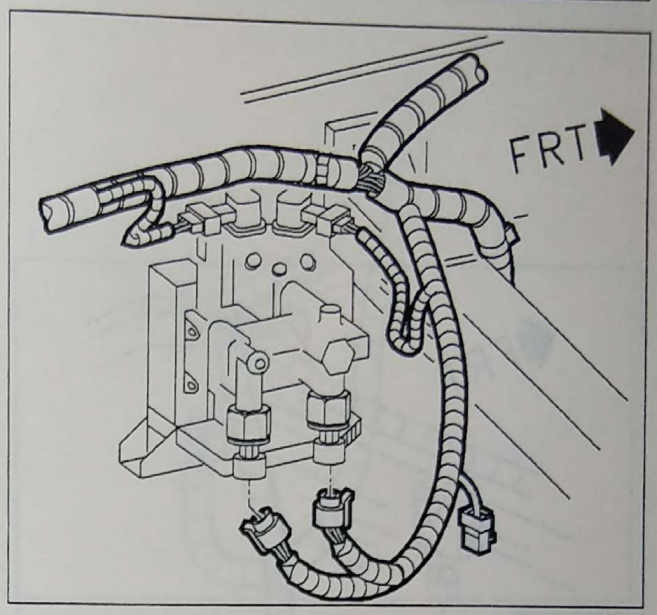
IMPORTANT: Brake pressure sensors are very fragile. Handle with care.

1. Install pressure sensor into modulator assembly using a 1 1/16 in crowsfoot and universal joint.

Torque: 31 N•m (22 ft−lbs)

NOTICE: Do not over torque pressure sensor.

2. Connect electrical connector to pressure sensor.
3. Check the master cylinder reservoir brake fluid level. Fill as necessary and install reservoir cap.
4. Bleed brake system. (Refer to "Brake System Bleeding" in this manual.)



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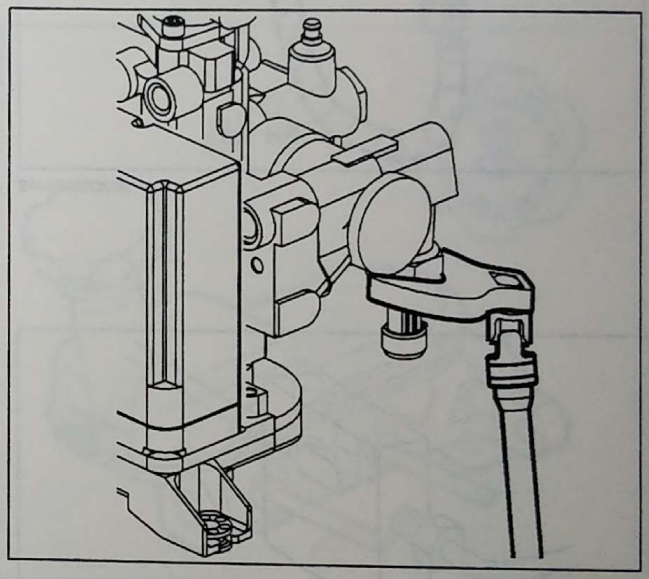

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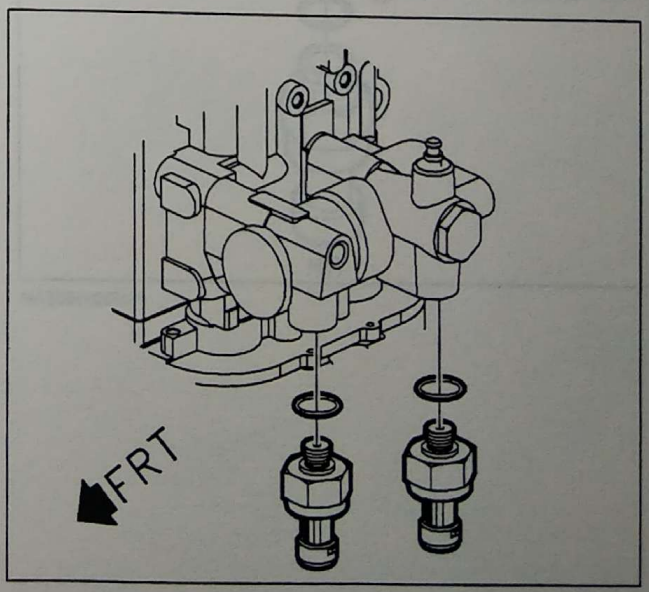

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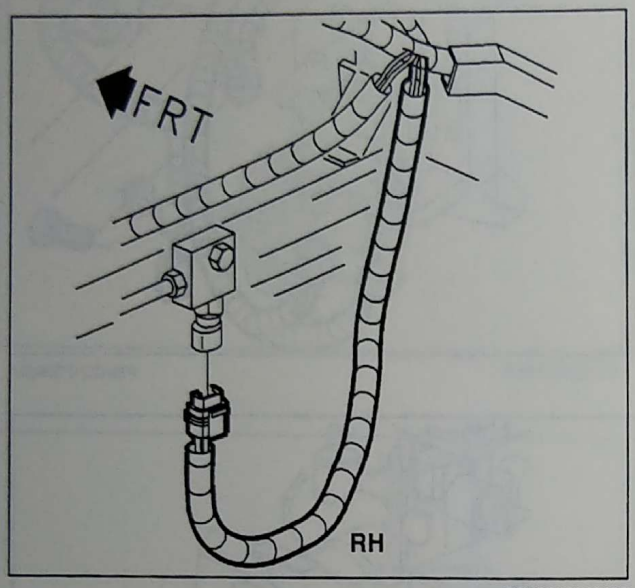
5. Install underbody front air deflector assembly. (Refer to "Underbody Front Air Deflector Assembly" in this manual.)

Torque: 6 N•m (53 in−lbs)

6. Lower vehicle from hoist.



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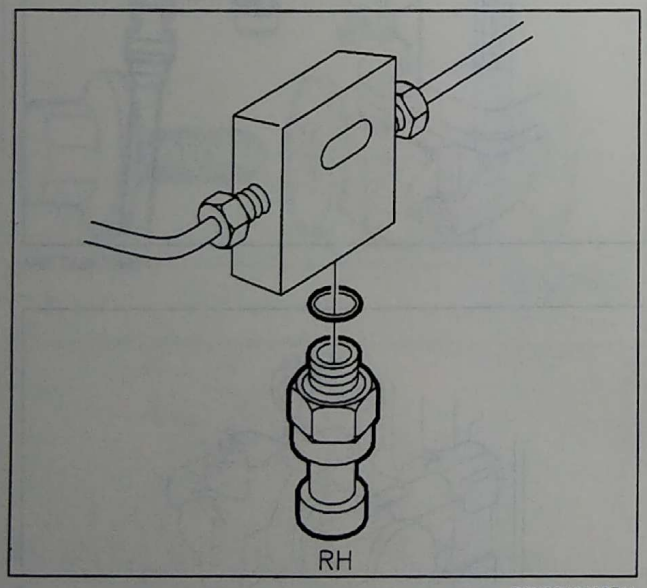

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BRAKE PRESSURE SENSOR DOWNSTREAM (PIPES) – RIGHT SIDE

REMOVAL

IMPORTANT: Place keypad in LOCK mode.

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
2. Remove underbody front air deflector assembly. (Refer to "Underbody Front Air Deflector Assembly" in this manual.)
3. Locate right side pressure sensor attached to the right side of the front crossmember, just in front of the power steering pump/motor assembly.
4. Remove electrical connector from brake pressure sensor.

IMPORTANT: Brake pressure sensors are very fragile. Handle with care.

NOTICE: Prior to servicing the pressure sensor be sure to clean pressure sensor and "T" assembly to ensure that no contaminants enter the brake system.

5. Loosen brake pressure sensor.

IMPORTANT: Use a shop cloth wrapped around the pressure sensor to catch any dripping brake fluid.

6. Remove sensor by hand.

NOTICE: Brake fluid is corrosive and will damage painted surfaces. Take care not to allow brake fluid to contact painted surfaces or electrical connectors. Clean shop cloths and clean containers should be used in case of spillage of brake fluid.

INSTALLATION

NOTICE: O-ring material is special. Only use original equipment O-ring. A new O-ring must be installed anytime pressure sensor is removed. Do not lubricate O-ring.

IMPORTANT: Brake pressure sensors are very fragile. Handle with care.

NOTICE: Do not over torque pressure sensor.

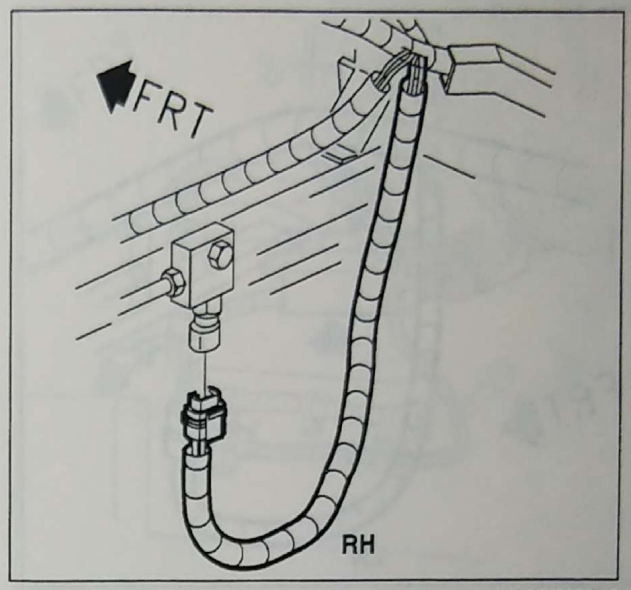
1. Install pressure sensor into "T" assembly.

Torque: 31 N•m (22 ft−lbs)

2. Connect electrical connector to pressure sensor.
3. Check the master cylinder reservoir brake fluid level. Fill as necessary and install reservoir cap.
4. Bleed brake system. (Refer to "Brake System Bleeding" in this manual.
5. Install underbody front air deflector assembly. (Refer to "Underbody Front Air Deflector Assembly" in this manual.)

Torque: 6 N•m (53 in−lbs)

6. Lower vehicle from hoist.



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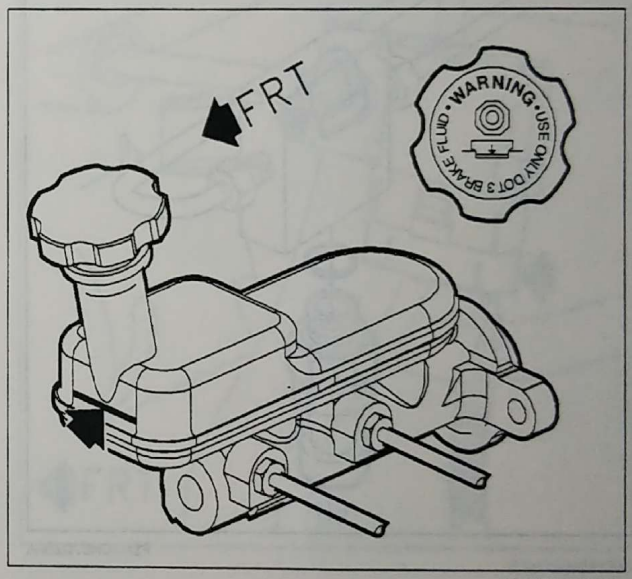

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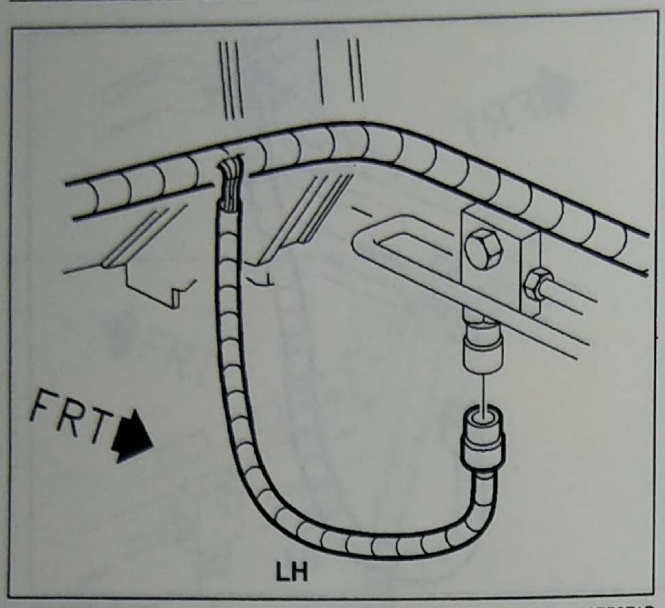

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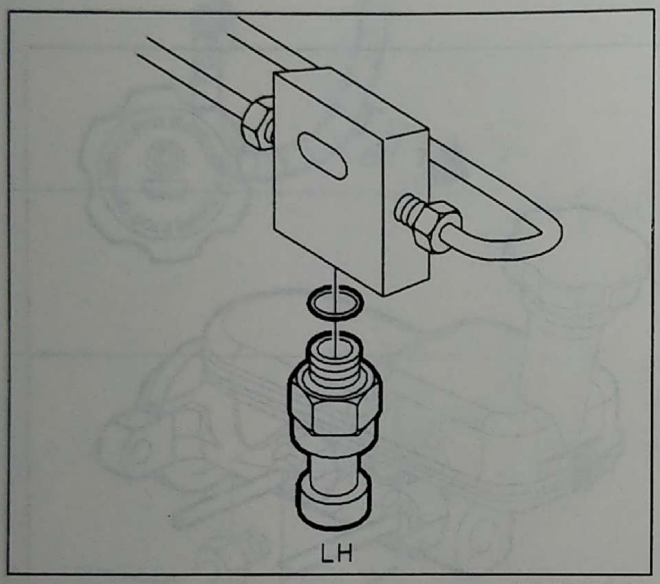

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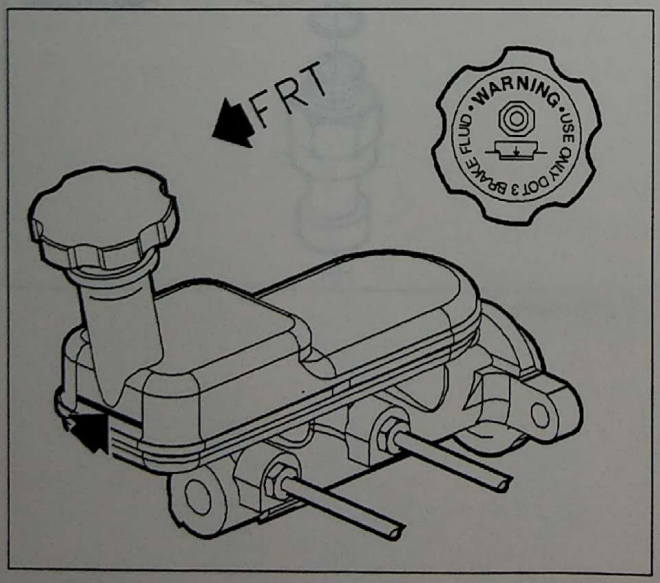

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BRAKE PRESSURE SENSOR DOWNSTREAM (PIPES) – LEFT SIDE

REMOVAL

IMPORTANT: Place keypad in LOCK mode.

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
2. Locate left side pressure sensor attached to the rear of the left side motor compartment inner midrail inboard.
3. Remove electrical connector from brake pressure sensor.

IMPORTANT: Brake pressure sensors are very fragile. Handle with care.

NOTICE: Prior to servicing the pressure sensor be sure to clean pressure sensor and "T" assembly to ensure that no contaminants enter the brake system.

4. Loosen brake pressure sensor.

IMPORTANT: Use a shop cloth wrapped around the pressure sensor to catch any dripping brake fluid.

5. Remove sensor by hand.

NOTICE: Brake fluid is corrosive and will damage painted surfaces. Take care not to allow brake fluid to contact painted surfaces or electrical connectors. Clean shop cloths and clean containers should be used in case of spillage of brake fluid.

INSTALLATION

NOTICE: O-ring material is special. Only use original equipment O-ring. A new O-ring must be installed anytime pressure sensor is removed. do not lubricate O-ring.

IMPORTANT: Brake pressure sensors are very fragile. Handle with care.

1. Install pressure sensor into tee assembly.

Torque: 31 N•m (22 ft–lbs)

IMPORTANT: Do not over torque pressure sensor.

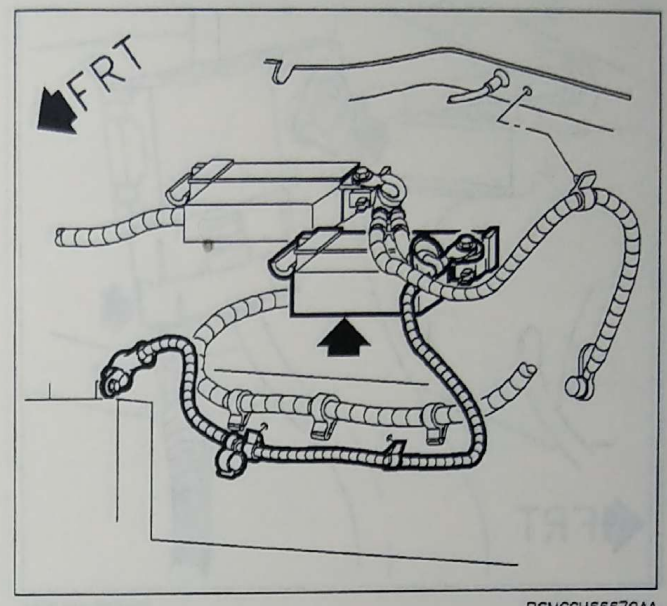
2. Connect electrical connector to pressure sensor.
3. Check the master cylinder reservoir brake fluid level. Fill as necessary and install reservoir cap.
4. Bleed brake system. (Refer to "Brake System Bleeding" in this manual.)

STOP LAMP SWITCH

REMOVAL

IMPORTANT: Place keypad in LOCK mode.

1. Disable the SIR system. (Refer to "Disabling the SIR System" in this manual.)
2. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.



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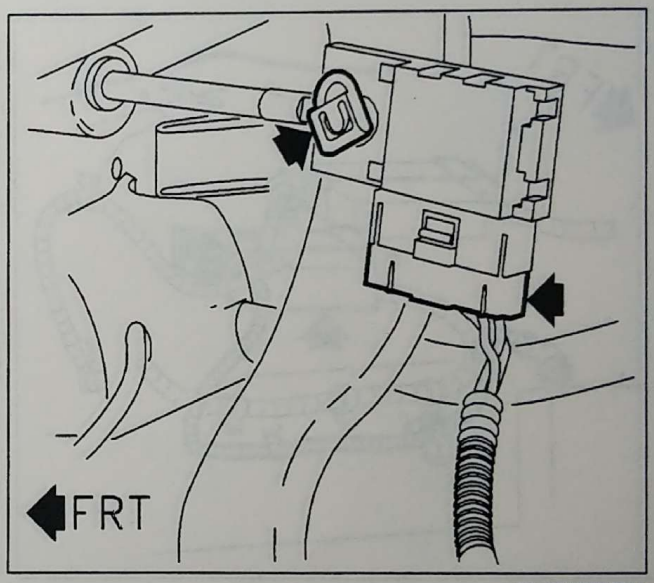
3. Locate stop lamp switch. Stop lamp switch is attached to the top portion of the brake pedal.
4. Disconnect electrical connector at stop lamp switch.
5. Remove retainer securing stop lamp switch and master cylinder push rod from brake pedal push rod pin.
6. Slide washer, stop lamp switch and master cylinder push rod off brake pedal push rod pin.



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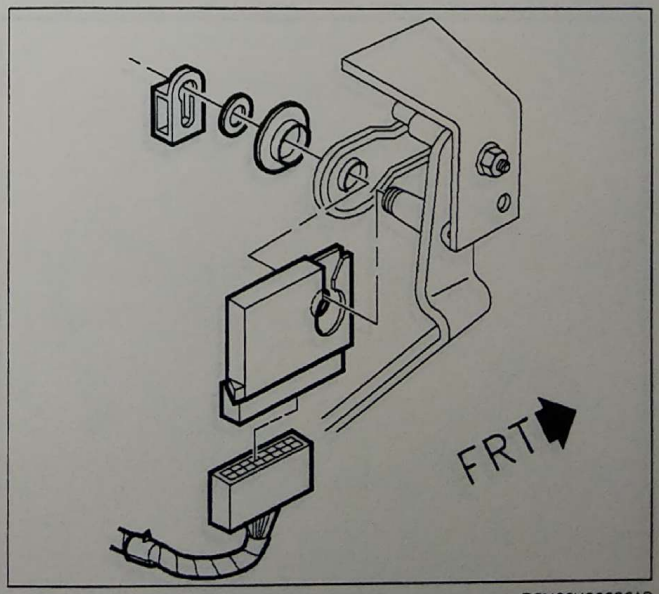
INSTALLATION

1. Lubricate brake pedal push rod pin (360°, full length) and brake pedal in area where stop lamp switch makes contact with GM part number 12377985 (or equivalent).
2. Install stop lamp switch onto master cylinder push rod.
3. Align holes in stop lamp switch and push rod, slide assembly over brake pedal pin.

IMPORTANT: Make sure stop lamp switch body rest on top of anti-rotation pin. Stop lamp switch when properly installed will be parallel to the floorboard with wire connector facing down.



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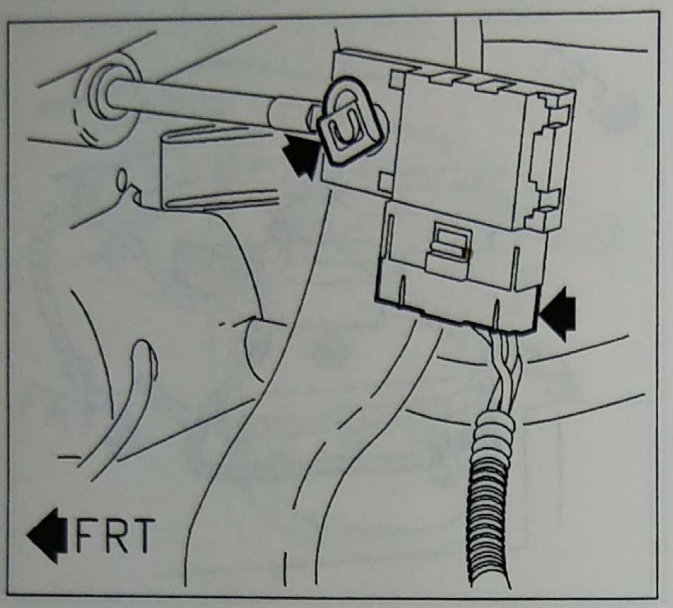

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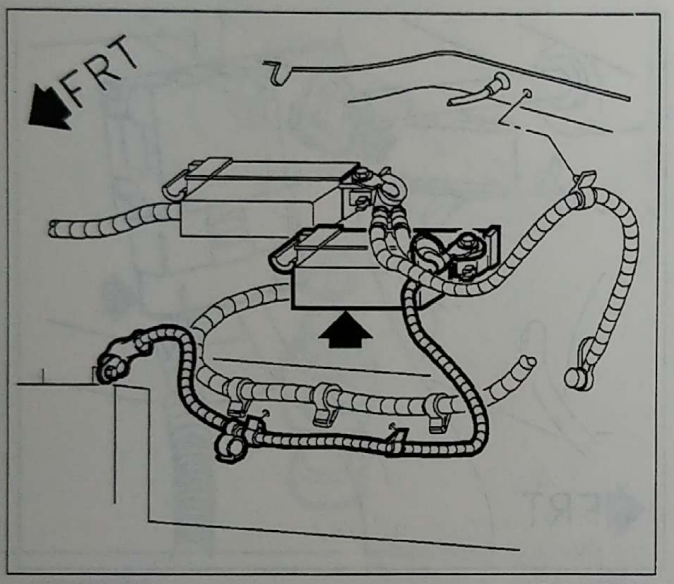

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4. Install washer to brake pedal push rod pin and secure with retainer.

IMPORTANT: Align so smaller portion of washer inserts into stop lamp switch.

5. Snap retainer into place. Rotate retainer 360 degrees in each direction while maintaining pressure on retainer to insure retainer is properly seated.
6. Connect electrical connector to stop lamp switch.

IMPORTANT: Check to be sure that electrical connector is fully seated and latches are engaged (push, click, tug).

7. Install Turn/Modules maxi fuse into lower maxi fuse block, located underhood between PEB and front of dash.

IMPORTANT: Stop lamp switch requires no adjustment.

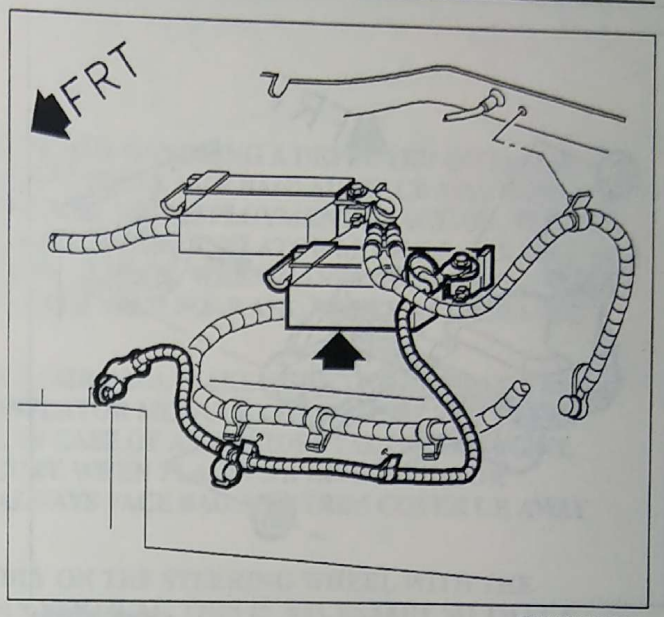
8. Check brake system for proper operation.
9. Enable the SIR system. (Refer to "Enabling the SIR System" in this manual.)

BRAKE PEDAL PUSH ROD

REMOVAL

IMPORTANT: Place keypad in LOCK mode.

1. Disable the SIR system. (Refer to "Disabling the SIR System" in this manual.)
2. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.
3. Locate stop lamp switch. Stop lamp switch is attached to the top portion of the brake pedal.



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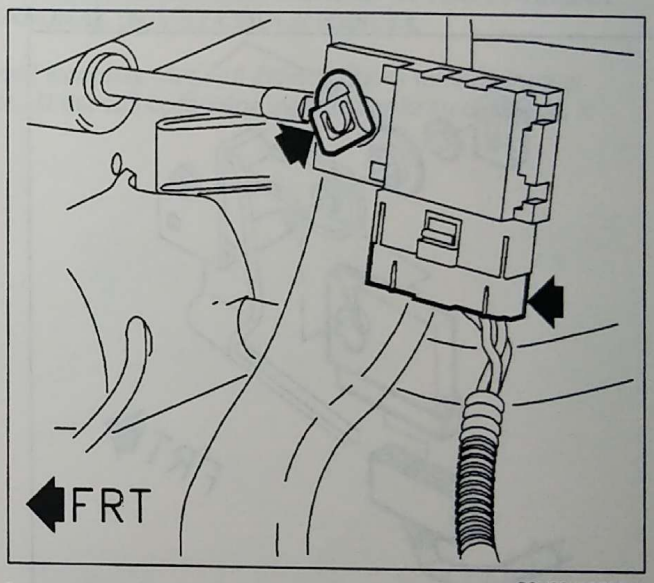
4. Remove retainer securing stop lamp switch and master cylinder push rod from brake pedal push rod pin.
5. Slide washer, stop lamp switch and master cylinder push rod off brake pedal push rod pin.
6. Raise hood.
7. Remove two nuts securing master cylinder to front of dash.



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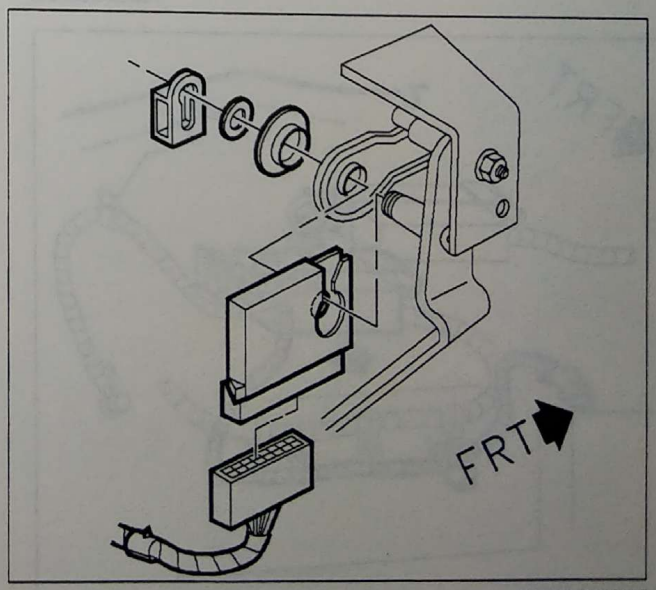
8. Cautiously move master cylinder enough to access master cylinder push rod.

IMPORTANT: Be careful not to bend brake lines.

9. Remove master cylinder push rod from front of dash by using a back and forth (wiggling) motion, while pulling outward.



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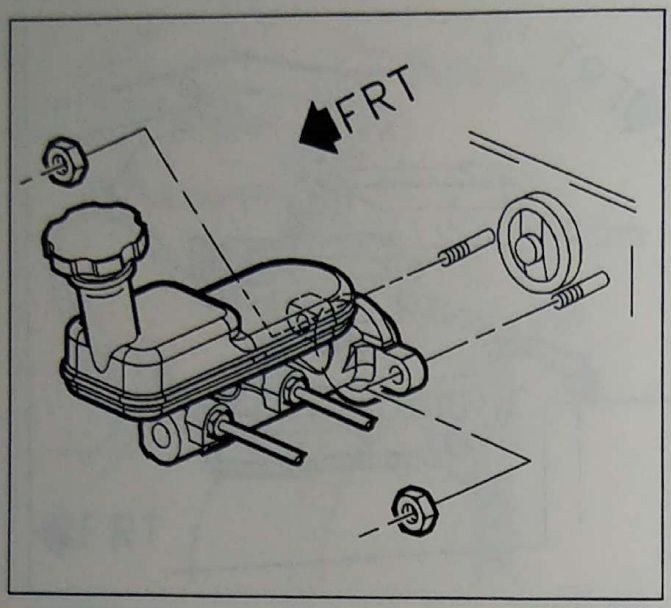

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INSTALLATION

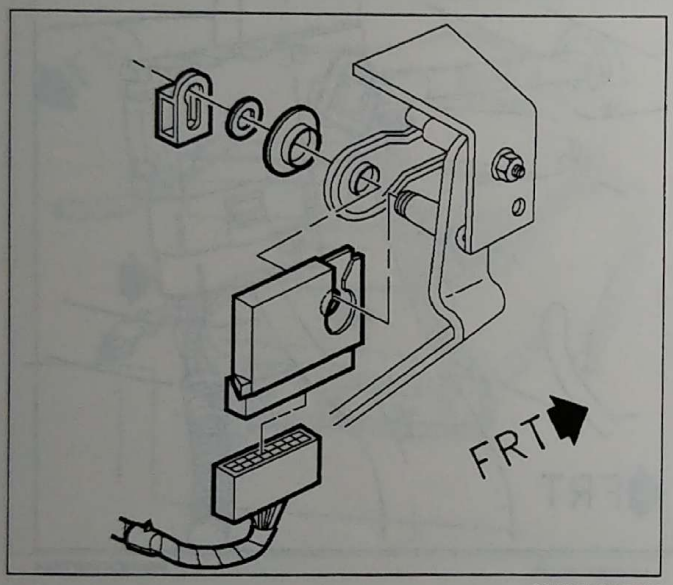
1. Insert master cylinder push rod through front of dash.

NOTICE: Check to make sure that the slot in the push rod is VERTICAL and that it aligns with the master cylinder.

2. Position master cylinder onto studs at front of dash and install fastening nuts.

Torque: 27 N•m (20 ft−lbs)

3. Lubricate brake pedal push rod pin (360°, full length) and brake pedal in area where stop lamp switch makes contact with GM part number 12377985 (or equivalent).
4. Install stop lamp switch onto master cylinder push rod.



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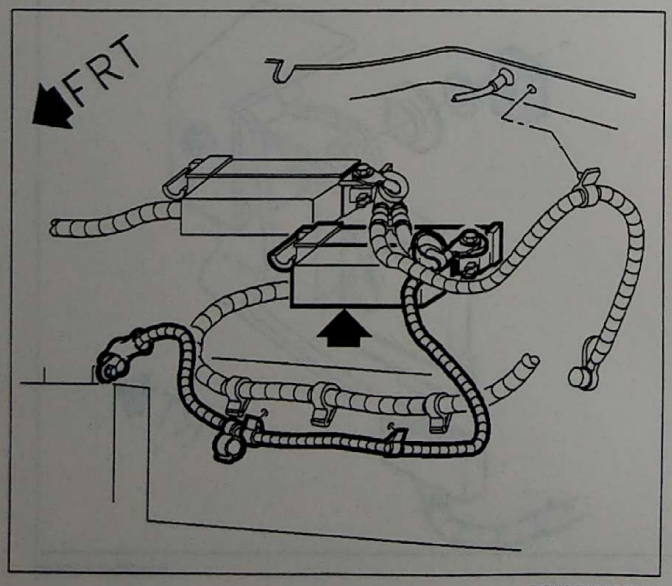
5. Align holes in stop lamp switch and push rod, slide assembly over brake pedal pin.

IMPORTANT: Make sure stop lamp switch body rest on top of anti-rotation pin. Stop lamp switch when properly installed will be parallel to the floorboard with wire connector facing down.

6. Install washer to brake pedal push rod pin and secure with retainer.

IMPORTANT: Align so smaller portion of washer inserts into stop lamp switch.

7. Snap retainer into place. Rotate retainer 360° in each direction while maintaining pressure on retainer to insure retainer is properly seated.



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8. Install Turn/Modules maxi fuse into lower maxi fuse block, located underhood between PEB and front of dash.
9. Enable the SIR system. (Refer to "Enabling the SIR System" in this manual.)
10. Check brake system for proper operation.

STEERING COLUMN

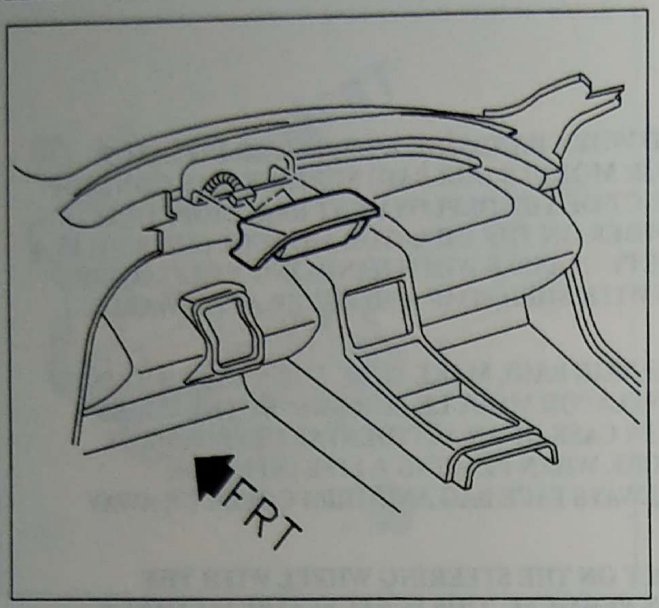
CAUTION: SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN HANDLING A DEPLOYED INFLATOR MODULE (AIR BAG). AFTER DEPLOYMENT, THE INFLATOR MODULE (AIR BAG) SURFACE MAY CONTAIN A SMALL AMOUNT OF SODIUM HYDROXIDE, A BY-PRODUCT OF THE DEPLOYMENT REACTION, THAT IS IRRITATING TO THE SKIN AND EYES. MOST OF THE POWDER ON THE INFLATOR MODULE (AIR BAG) IS HARMLESS. AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED INFLATOR MODULE (AIR BAG), AND WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

CAUTION: WHEN CARRYING A LIVE INFLATOR MODULE (AIR BAG), MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOU. NEVER CARRY INFLATOR MODULE (AIR BAG) BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF THE MODULE. IN CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL DEPLOY WITH MINIMAL CHANCE OF INJURY. WHEN PLACING A LIVE INFLATOR MODULE (AIR BAG) ON A BENCH OR OTHER SURFACE, ALWAYS FACE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE.

CAUTION: NEVER REST A STEERING COLUMN ASSEMBLY ON THE STEERING WHEEL WITH THE INFLATOR MODULE (AIR BAG) FACE DOWN AND COLUMN VERTICAL. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE INFLATOR MODULE (AIR BAG) TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY COULD RESULT.

IMPORTANT: In the event deployment has occurred, inspect coil assembly wire and driver inflator module for any signs of scorching, melting or other damage due to excessive heat. If the coil or inflator module has been damaged, it must be replaced.

CamScanner



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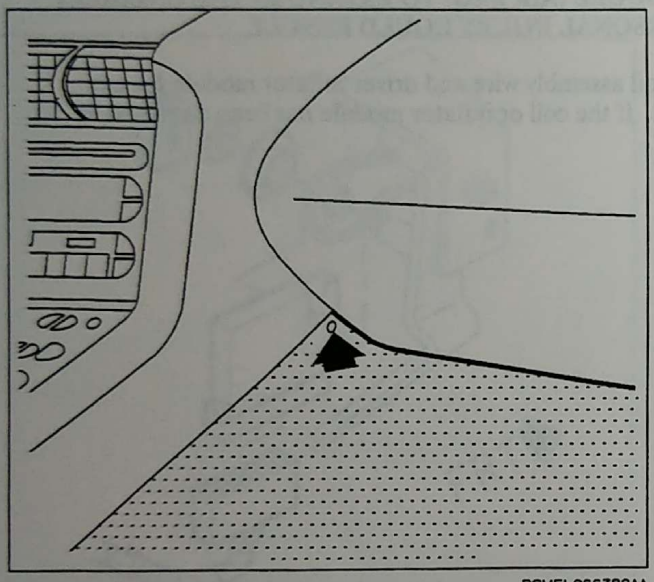

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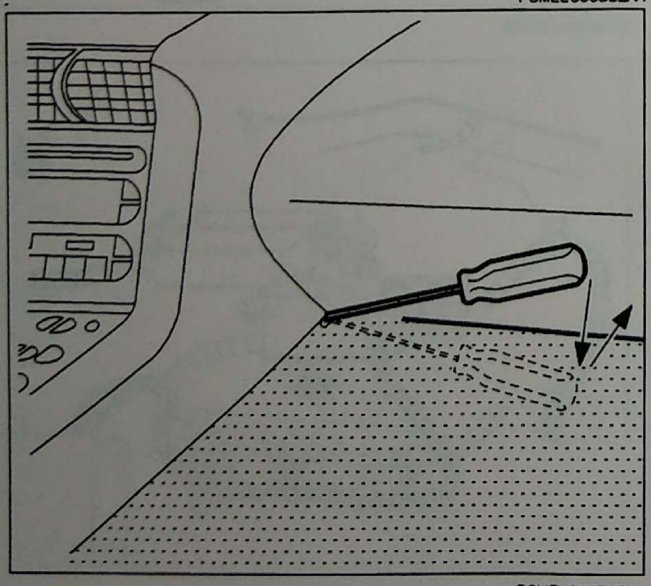

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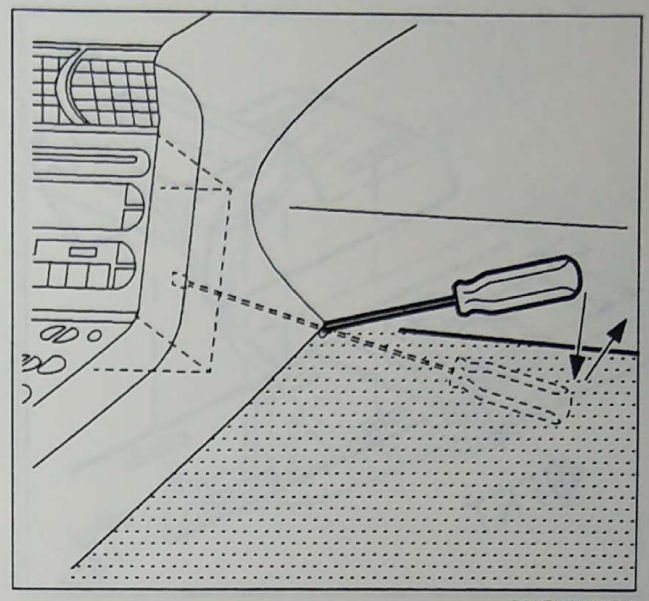
BRAKE PEDAL/BRACKET ASSEMBLY

REMOVAL

1. Disable the SIR system. (Refer to "Disabling the SIR System" in this manual.)
2. Remove instrument panel cluster (IPC) by lifting upward and rearward, disconnect the IPC connector.
3. Locate hole in instrument panel tunnel bracket on right side behind carpet.
4. Use a knife to make a small slit in carpet over the hole.
5. Insert a screwdriver with a blade about 152-304 mm (6 in.−12 in.) long into the hole in the instrument panel tunnel bracket. Slide screwdriver along instrument panel radio bracket until the screwdriver is wedged between bracket and the radio lock tab. The screwdriver should be inserted about 152 mm (6 in.).

6. Push downward then forward on the screwdriver handle, lifting the lock tab upward and the radio rearward simultaneously. The radio should move rearward enough so that it can be pulled out the rest of the way by hand.
7. With the brake applied, shift run/lock shift assembly (RSA) to DRIVE, then select ACCY mode to shut Off power and apply the parking brake to keep the vehicle from rolling unexpectedly.
8. Lay a clean shop rag over the RSA to help protect it from getting scratched by the radio case during radio removal.
9. Slide radio out of instrument panel.



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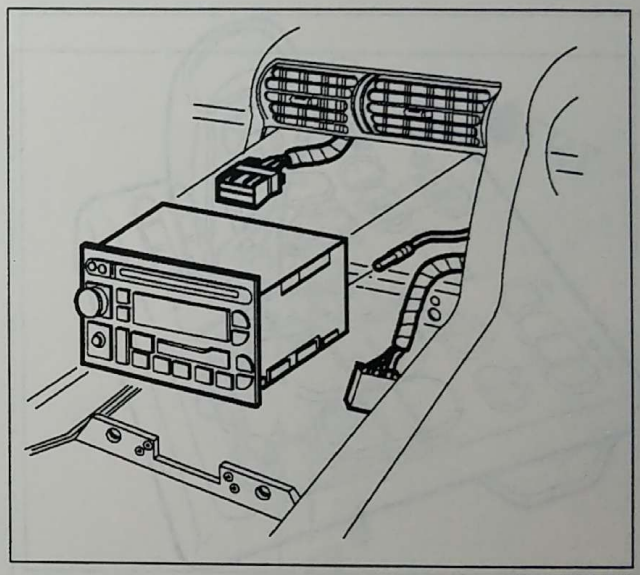
10. Disconnect the antenna lead first, then the harness connector.
11. With the brake applied, select the RUN mode again, and shift back to PARK. Then select the lock mode to turn the vehicle.



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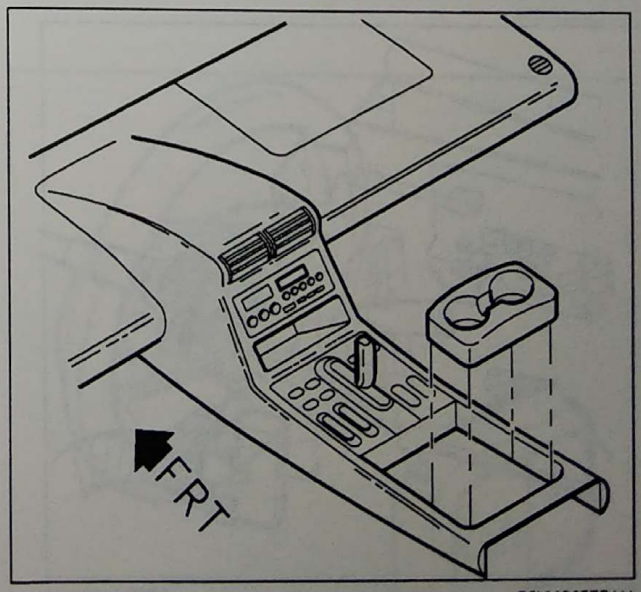
12. Remove cup holder.



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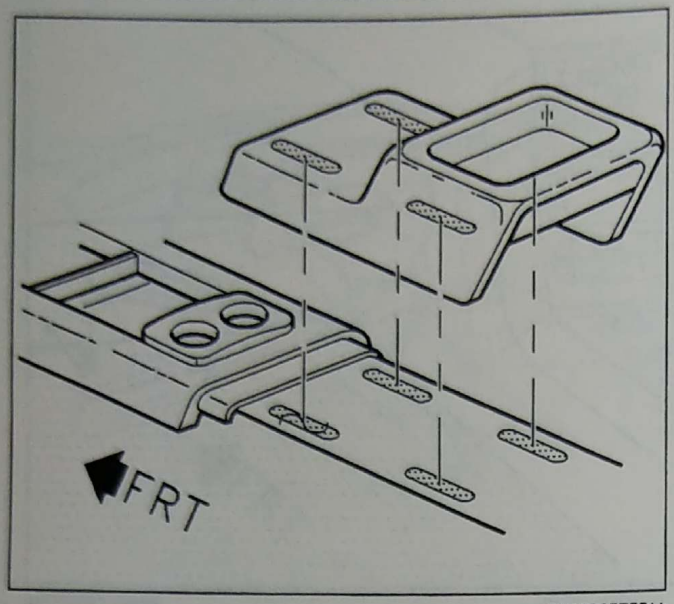

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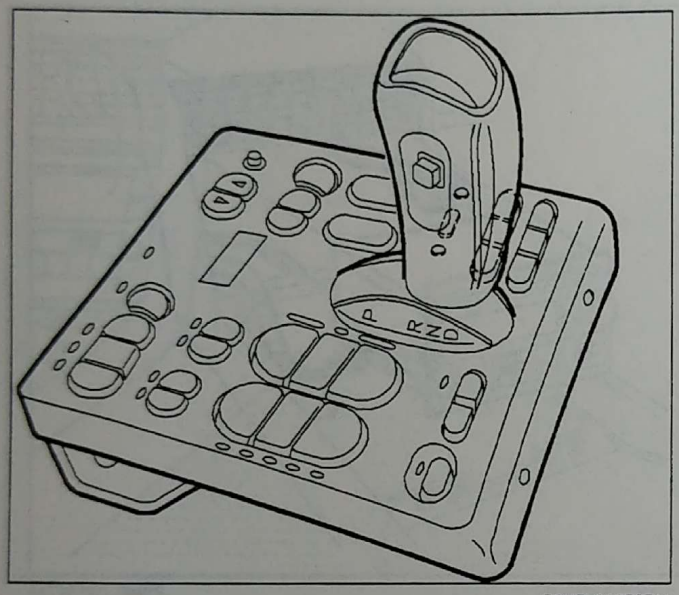
13. Remove arm rest from tunnel by lifting upward releasing Dual-Lock retainers.



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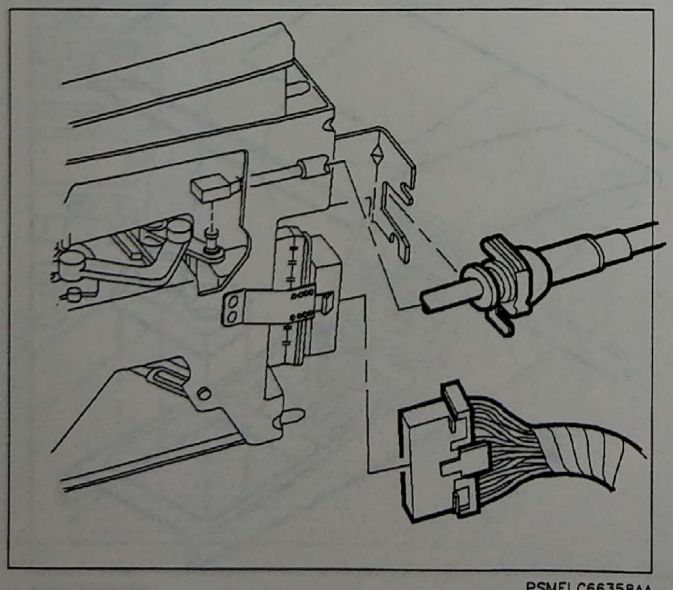
14. Remove the T-25 TORX™ screws in the rear of the RSA, pull RSA rearward about 63 mm (2.5 in.).



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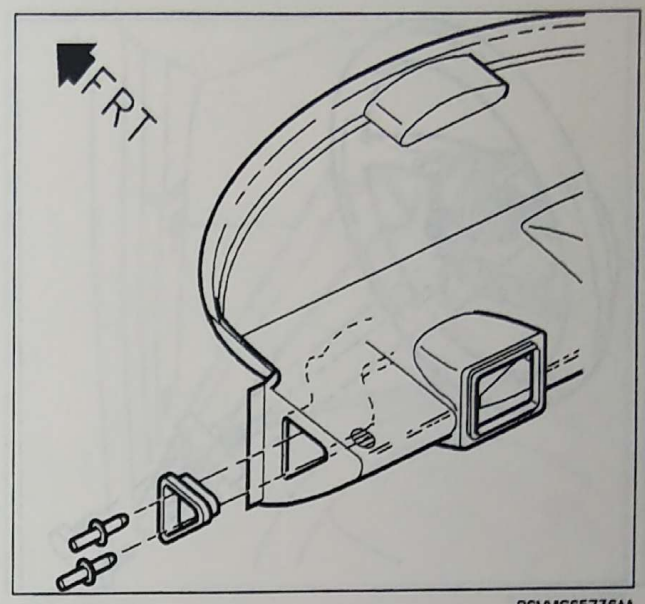
15. Rotate RSA towards the drivers side of the vehicle to a 45 angle.
16. Disconnect the RSA wire harness connector.
17. Disconnect the shift cable from the shifter and remove shift cable from retainer bracket by prying locking tab on drivers side of RSA gently and pushing cable down out of bracket.

18. Drill out rivets from side door air outlets.
19. Remove left and right front side door air outlets on the side of instrument panel with doors open.



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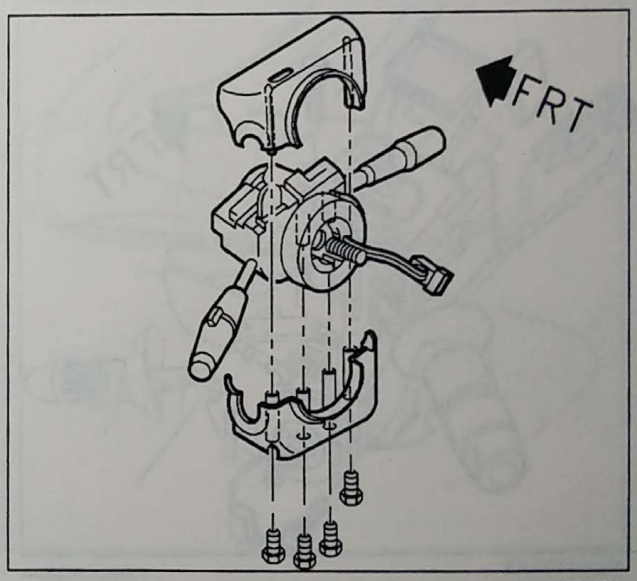
20. Remove outer screws from lower steering column trim cover, lift upper trim panel off.
21. Remove inner screws from lower steering column trim cover and remove lower trim cover.



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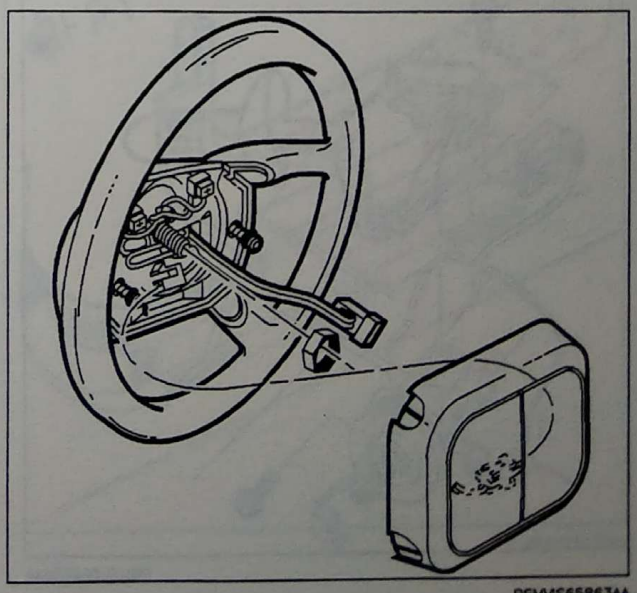
22. Remove screws from back of steering wheel that retains SIR inflator module.
23. Remove connector position assurance (CPA) and disconnect inflator module connector.
24. Remove SIR inflator module.



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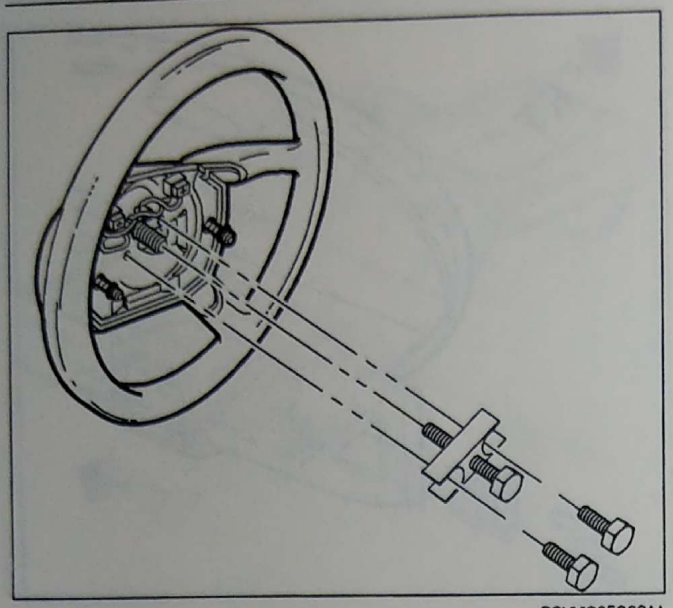

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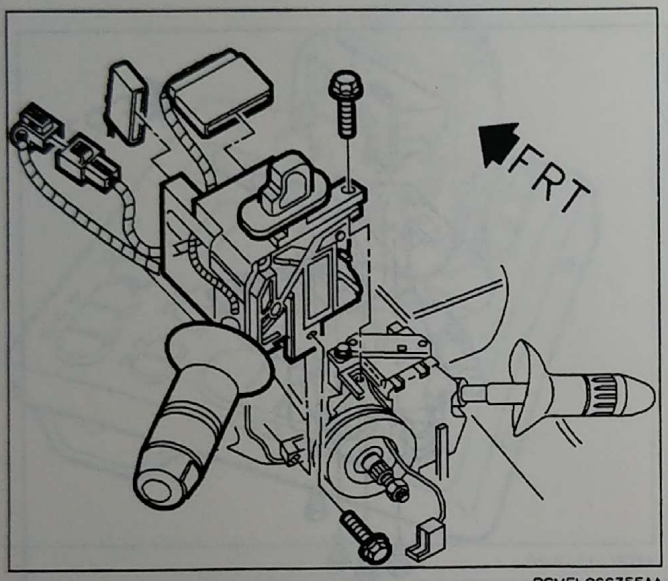
25. Disconnect horn switch connector.
26. Remove nut from steering column that retains steering wheel.
27. Install steering wheel puller SA9218NE and remove steering wheel.



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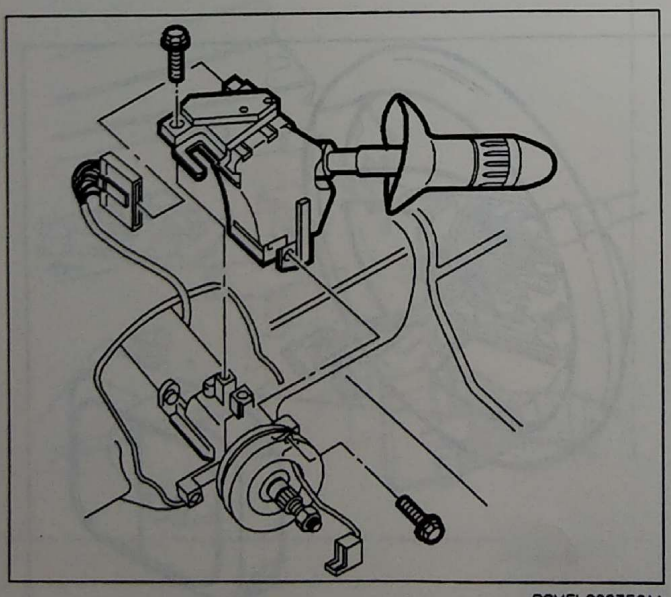
28. Remove T–25 TORX™ /7mm screws from turn signal, headlamp, and cruise switch.
29. Remove switch and disconnect switch connectors.



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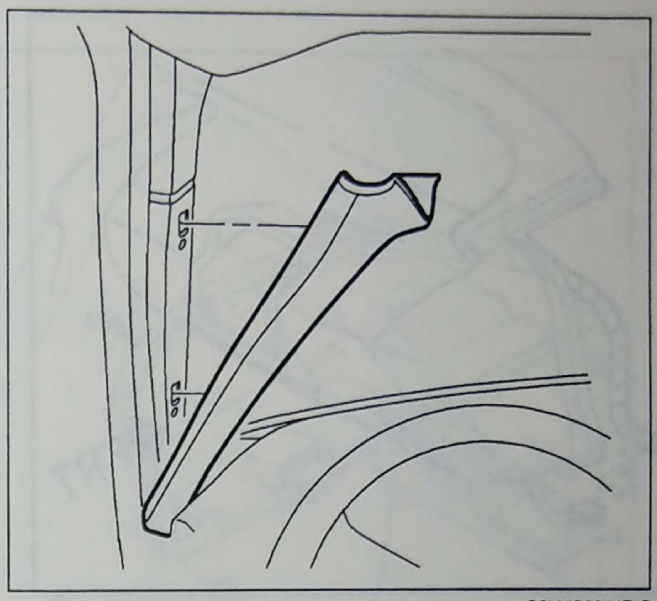
30. Remove T–25 TORX™ /7mm screws from windshield washer switch.
31. Disconnect connector and remove switch.

32. Starting at top of garnish molding, pull firmly at clip locations to disengage. Tipping the top of molding inward with the bottom engaged to instrument.



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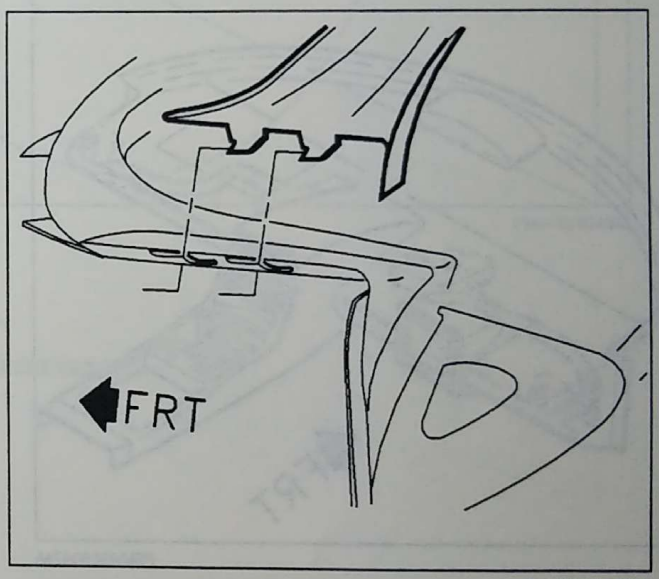
33. Disengage tabs on garnish molding from instrument panel by pulling rearward and inboard.



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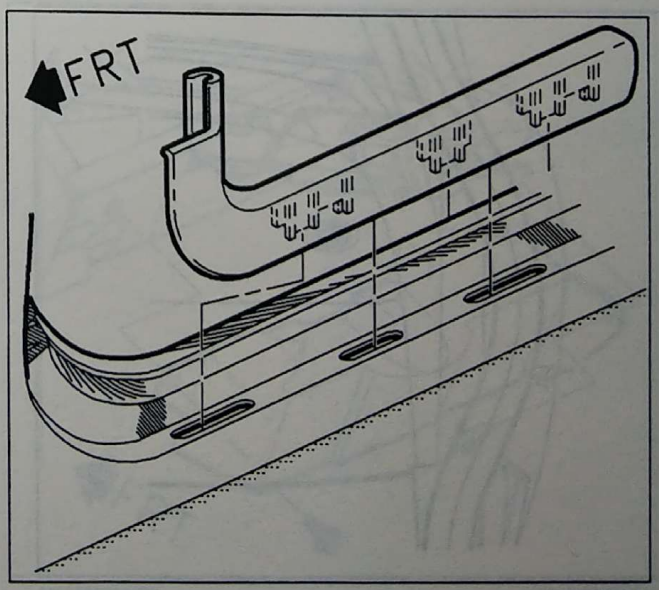
34. Starting at rear of carpet retainer, pull firmly on carpet retainer at clip locations to disengage clips.
35. Remove front side door opening floor carpet retainer.



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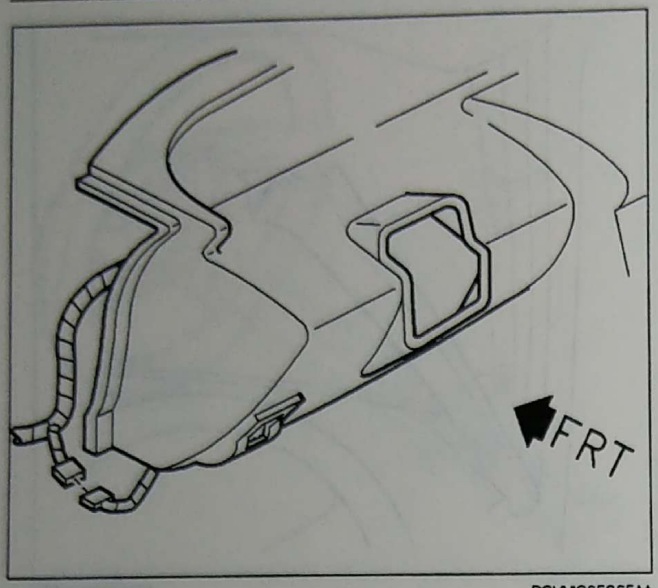

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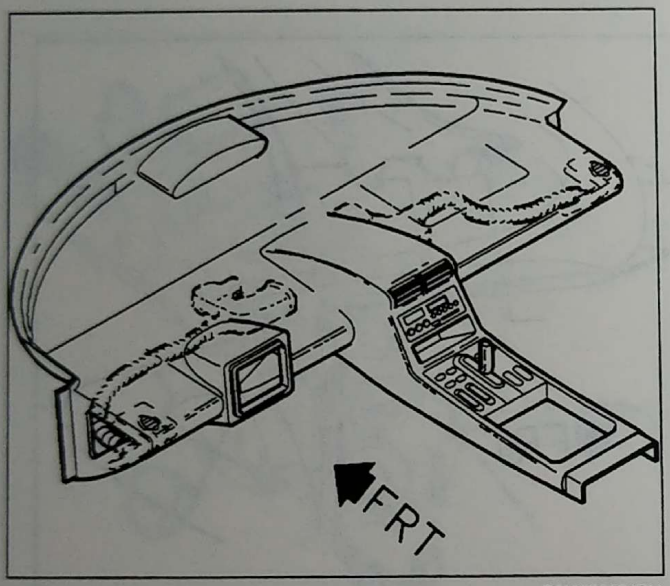
36. Disconnect parking brake switch connector.



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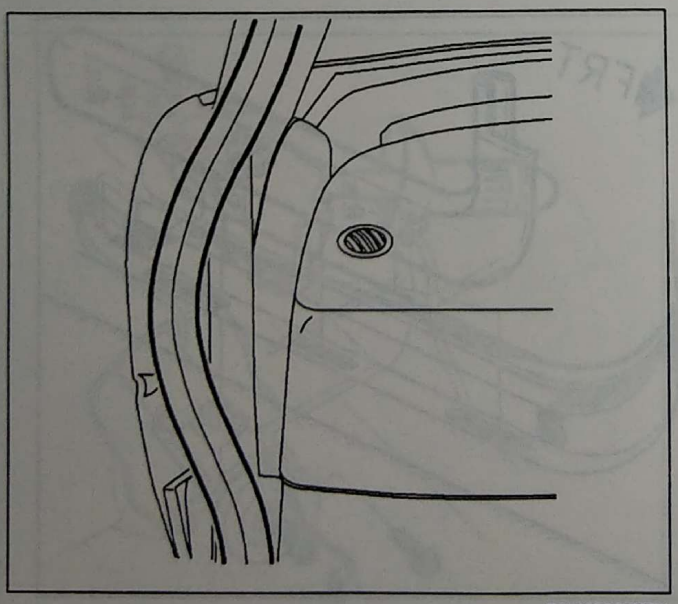
37. Disconnect side window demistor tubes from floor outlets.



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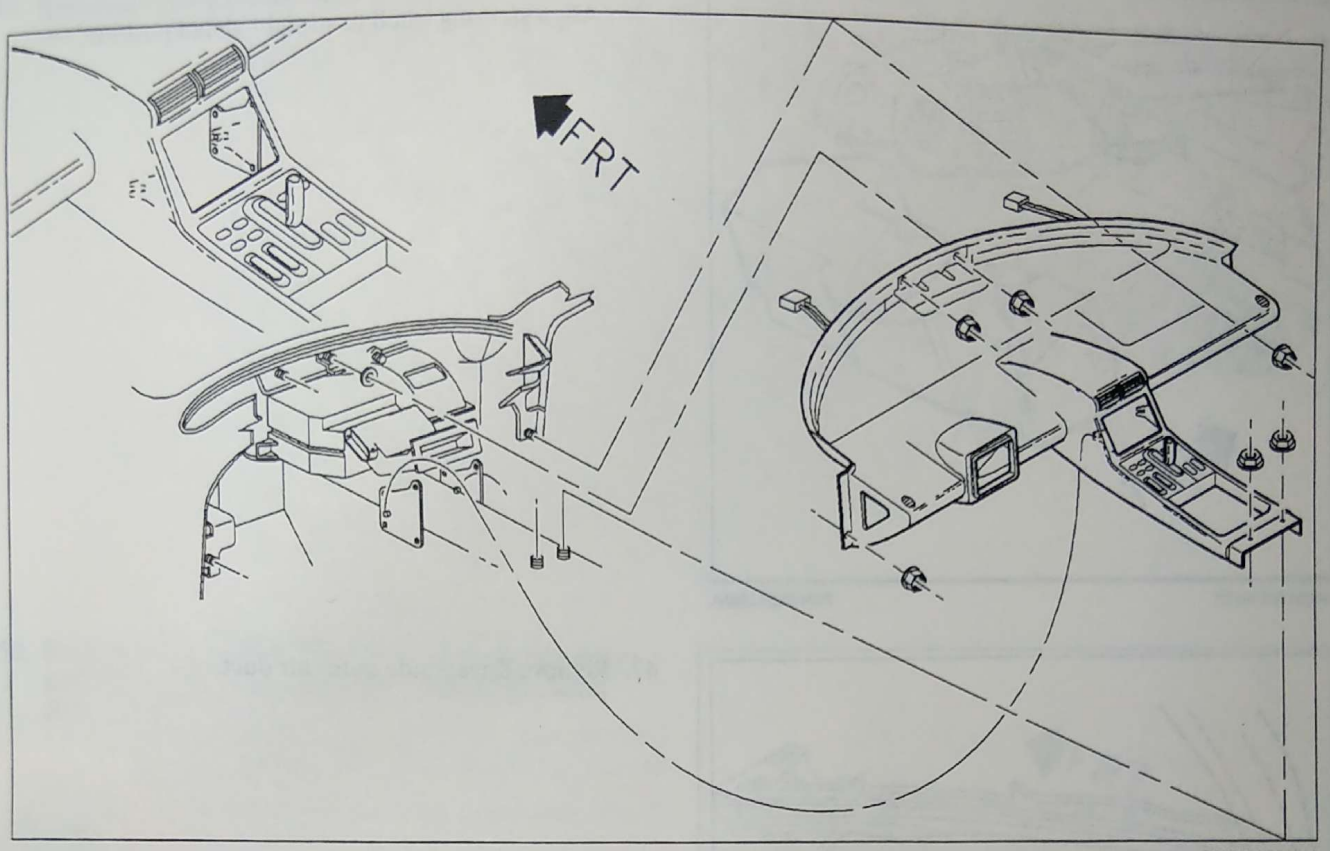
38. Remove side door weather strip from pinch weld flange near instrument panel.



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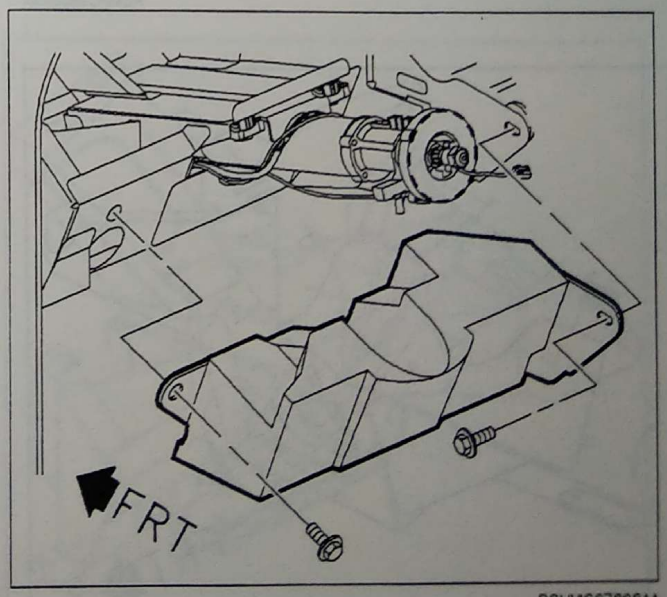
39. Remove retainers from instrument panel.
40. Pull instrument panel rearward with slight upward pressure.
41. Pull driver's side demister tube through hole in steering column support.
42. Disconnect both information telltale connectors.
43. Remove instrument panel from vehicle.
44. If driver's side kneebolster energy absorber is retained with bolts go to step 45. If energy absorber is retained with dual lock go to step 46.
45. Remove driver's side kneebolster energy absorber bolts. Remove driver's side kneebolster energy absorber from vehicle.



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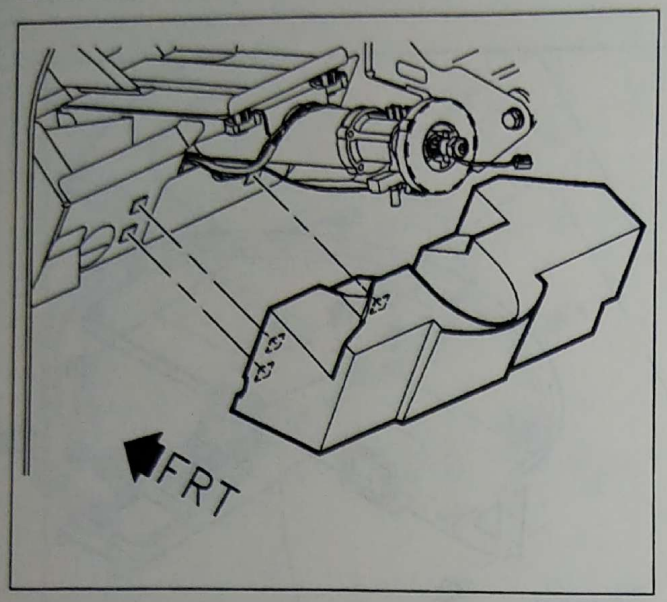
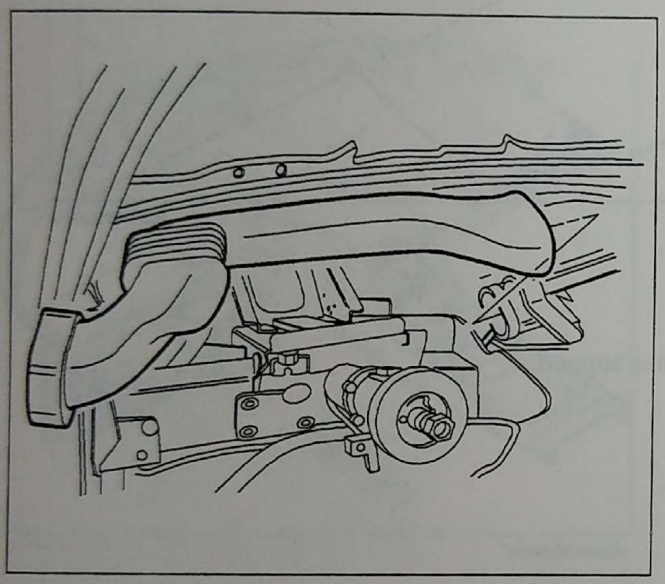


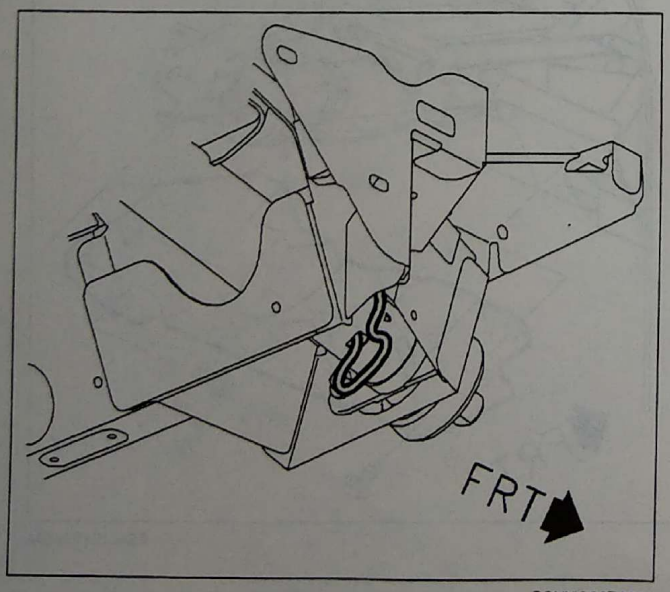
PSMVIS66338AA

46. Remove drivers side knee bolster energy absorber. Align steering whell to straight ahead position.



PSMVIS66336AA

47. Remove drivers side outer air duct.

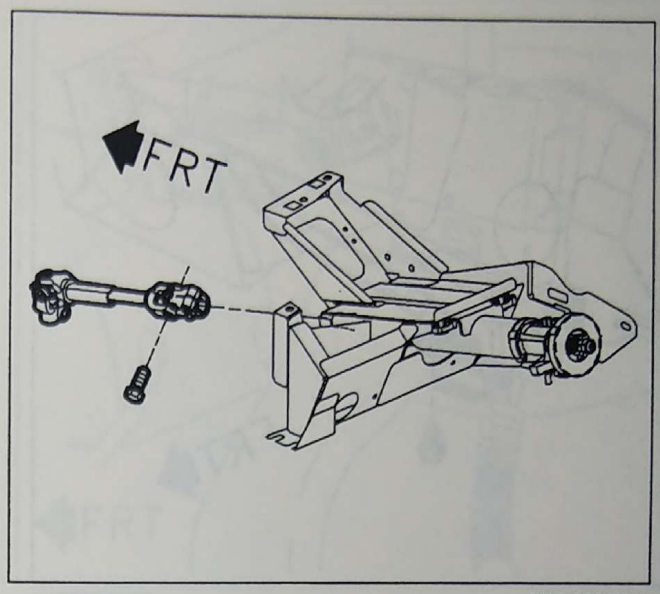


PSMVIS66762AA

48. Install steering column anti-rotation clip into base of column shaft.

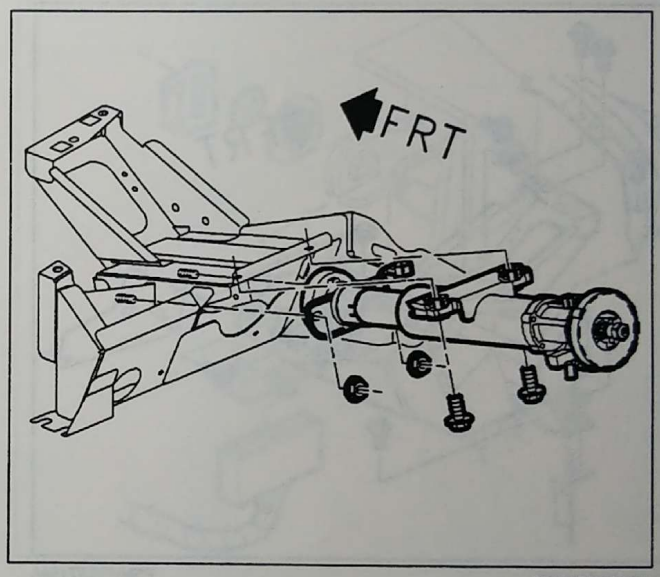
IMPORTANT: Anti-rotation clips are available from Saturn Service Parts.

49. Remove bolt from intermediate shaft and disconnect shaft from column.



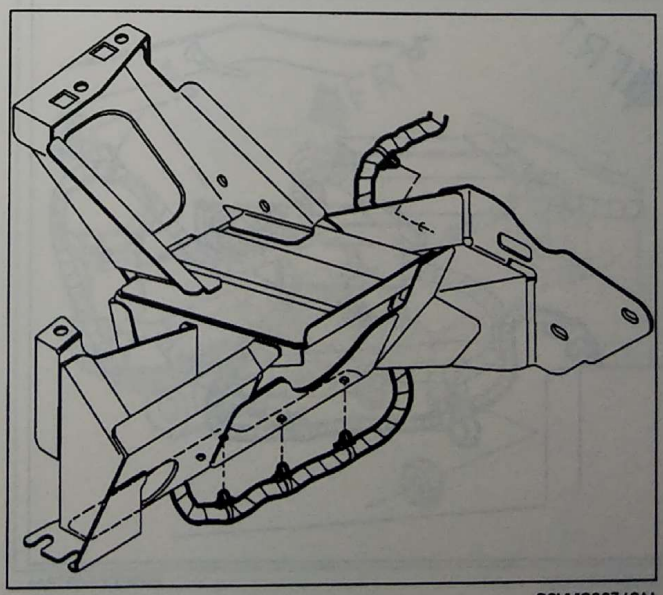
PSMVIS66790AA

50. Remove bolts and nuts that retain steering column to steering column support. Remove steering column from vehicle.



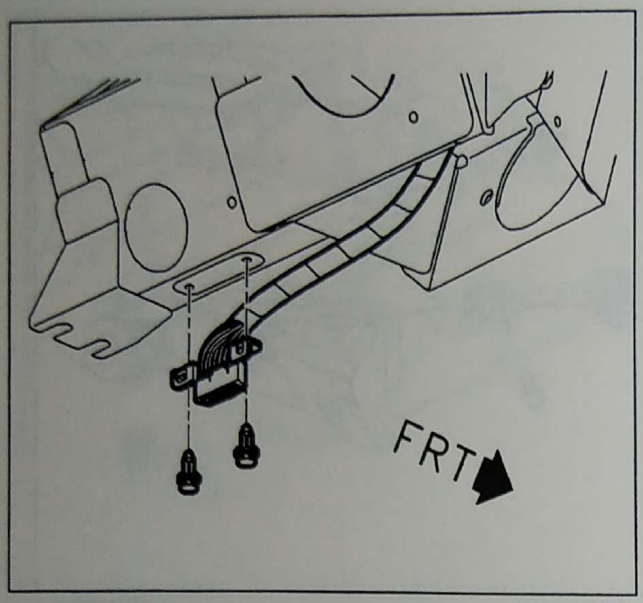
PSMVIS66718AA

51. Unclip wire harness rose buds from steering column support.



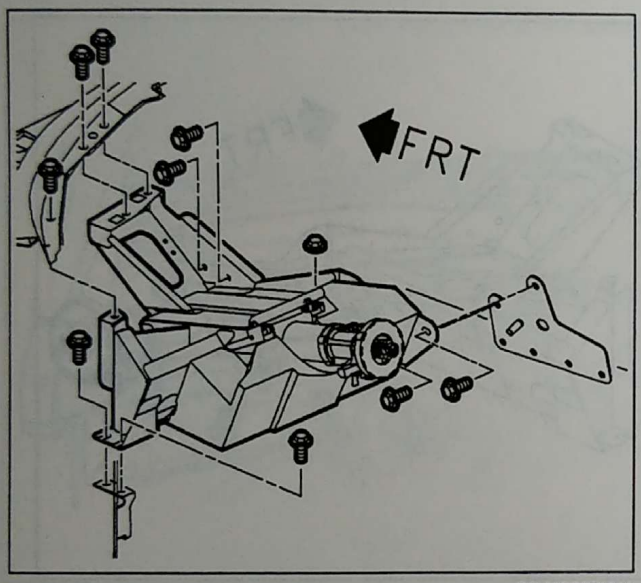
PSMVIS66340AA

CamScanner



PSMMS66339AA

52. Remove data link connector (DLC) connector from steering column support.
53. Loosen master cylinder nuts at front of dash.

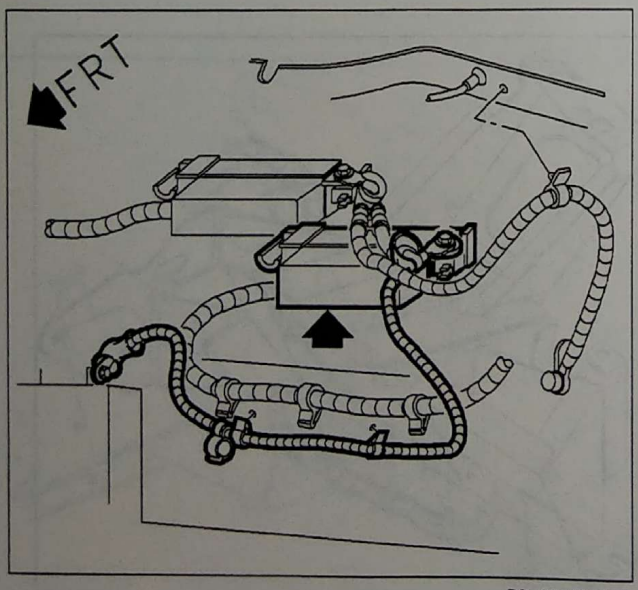


PSMMS66719AA

54. Remove bolts and nuts from steering column support.

IMPORTANT: Bolts at base of windshield will need to be removed with an open-end wrench.

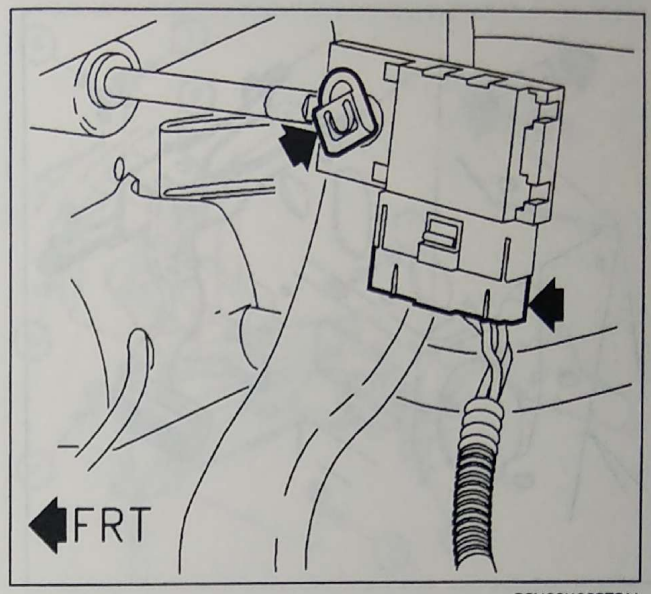
55. Remove steering column support from vehicle.



PSMGCH66679AA

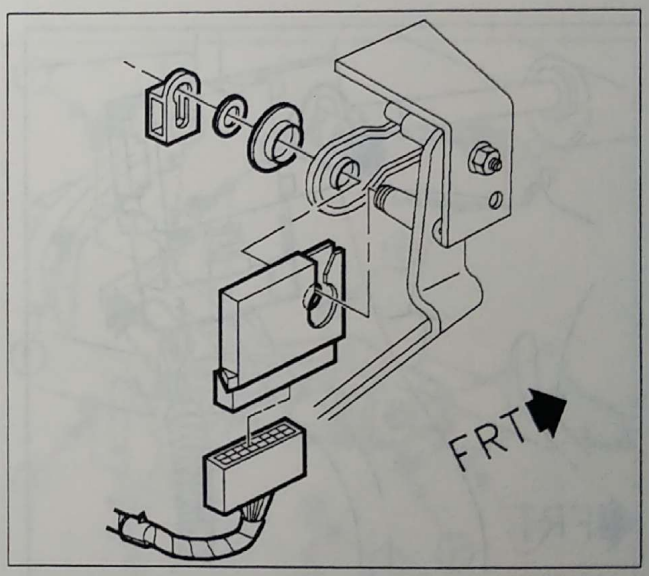
56. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.

57. Locate stop lamp switch. Stop lamp switch is attached to the top portion of the brake pedal.
58. Remove retainer securing stop lamp switch and master cylinder push rod to brake pedal push rod pin.



PSMGCH66878AA

59. Slide washer, stop lamp switch and master cylinder push rod off brake pedal push rod pin.
60. Raise hood.



PSMGCH66686AB

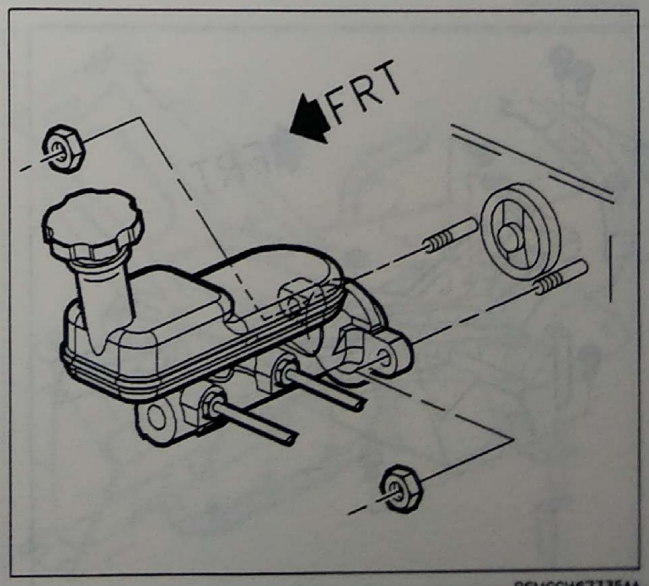
61. Remove two nuts securing master cylinder to front of dash.
62. Cautiously move master cylinder enough to clear brake pedal bracket studs.

IMPORTANT: Be careful not to bend brake lines.

63. Remove brake pedal/bracket assembly from vehicle.

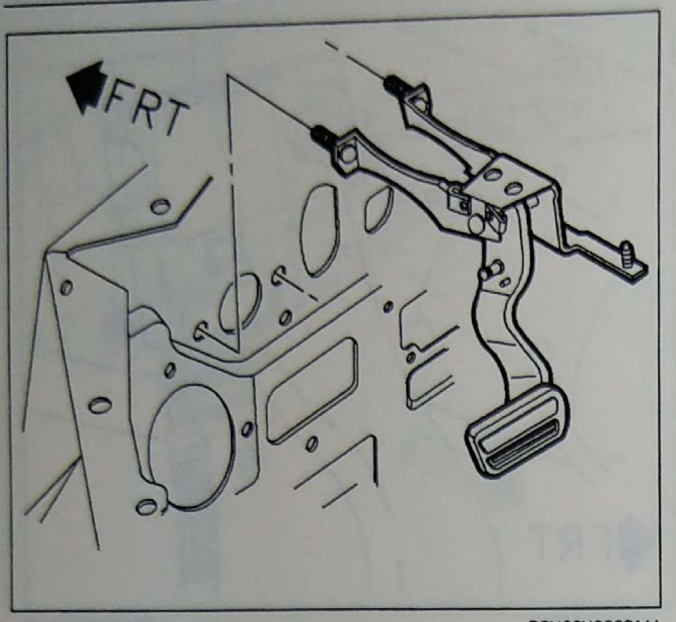
INSTALLATION

1. Install "J" nuts onto pedal/bracket assembly.
2. Position brake pedal/bracket assembly into the vehicle, inserting the bracket studs (master cylinder attachment) through the front dash.
3. From under hood, position master cylinder onto studs at front of dash and loose install fastening nuts.



PSMGCH67335AA

NOTICE: Check to make sure that the slot in the push rod is VERTICAL and that it aligns with the master cylinder.



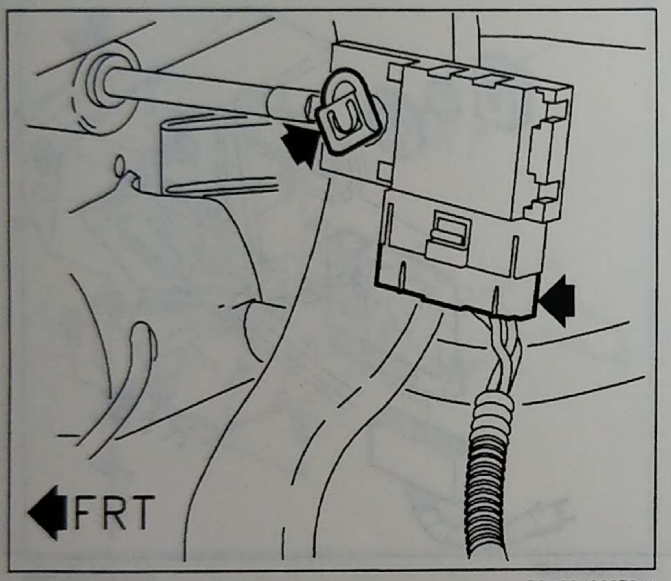
PSMGCH66681AA

IMPORTANT: Be careful not to bend brake lines.

4. From inside the vehicle, lubricate brake pedal push rod pin (360 degrees, full length) and brake pedal in area where stop lamp switch makes contact with brake pedal push rod lubricant GM part number 12377985 (or equivalent).
5. Install stop lamp switch onto master cylinder push rod.
6. Align holes in stop lamp switch and push rod, slide assembly over brake pedal pin.

IMPORTANT: Make sure stop lamp switch body rest on top of anti-rotation pin. Stop lamp switch when properly installed will be parallel to the floorboard, with electrical connector facing down.

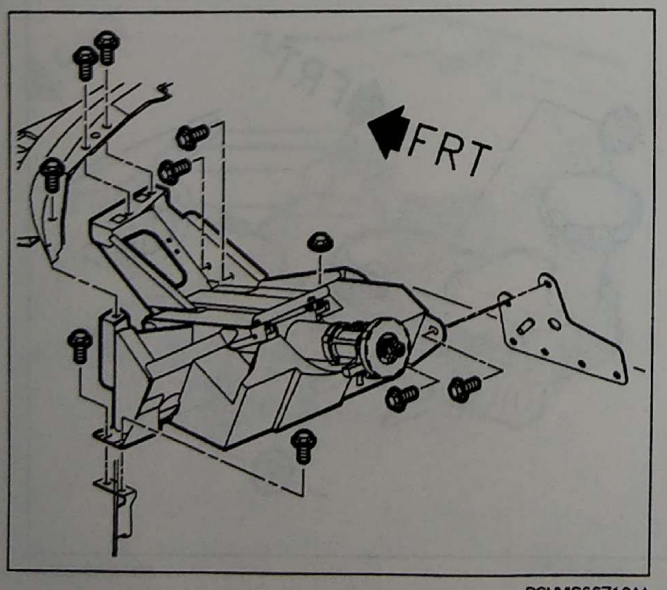
7. Install washer to brake pedal push rod pin and secure with retainer.



PSMGCH66878AA

IMPORTANT: Align smaller portion of washer inserts into stop lamp switch.

8. Snap retainer into place. Rotate retainer 360 degrees in each direction while maintaining pressure on retainer to insure retainer is properly seated.



PSMVIS66719AA

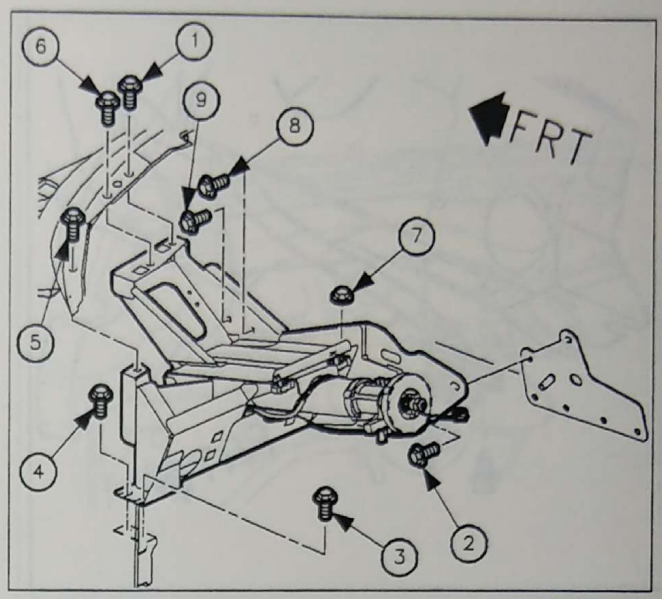
9. Load steering column support into vehicle. Hand tighten bolts.
10. Tighten master cylinder nuts onto studs at front of dash.

Torque: 27 N•m (20 ft−lbs)

11. If driver's side knee bolster energy absorber is retained with bolts, go to step 12 for torque sequence of steerng column support. If driver's side knee bolster energy absorber is retained with Dual-Lock, go to step 13 for torque sequence of stering support.

12. For energy absorbers retained with bolts, tighten steering column support bolts and nut in sequence shown.

Torque: **25 N•m (19 ft−lbs)**

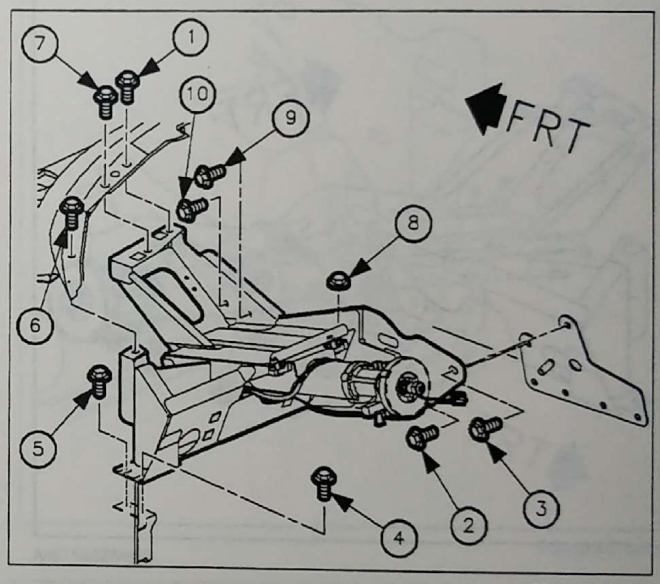


PSMVIS67850AA

13. For energy absorbers retained with Dual-Lock, tighten steering column support bolts and nut in sequence shown.

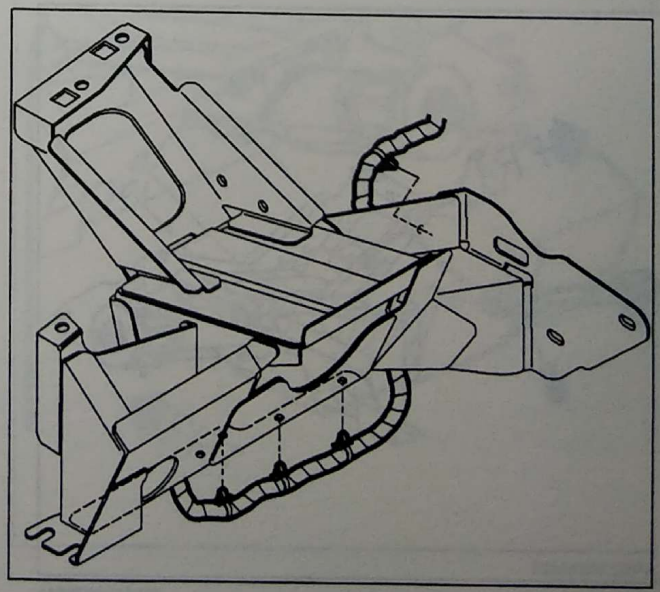
Torque: **25 N•m (19 ft−lbs)**

IMPORTANT: After tightening steering column support and brake pedal bracket bolts and nuts, check brake pedal movement for binding.



PSMVIS66840AB

14. Route wire harness and insert rose bud into steering column support. Refer to illustration.



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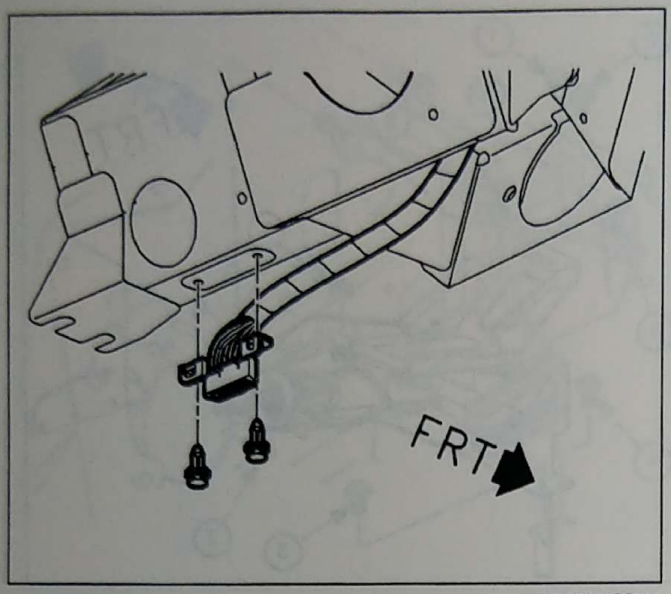
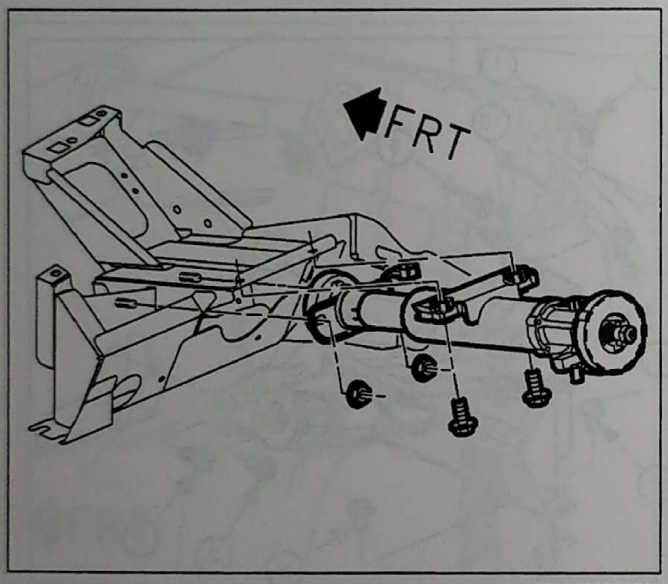


PSMVIS66339AA

15. Install DLC connector to steering column support.



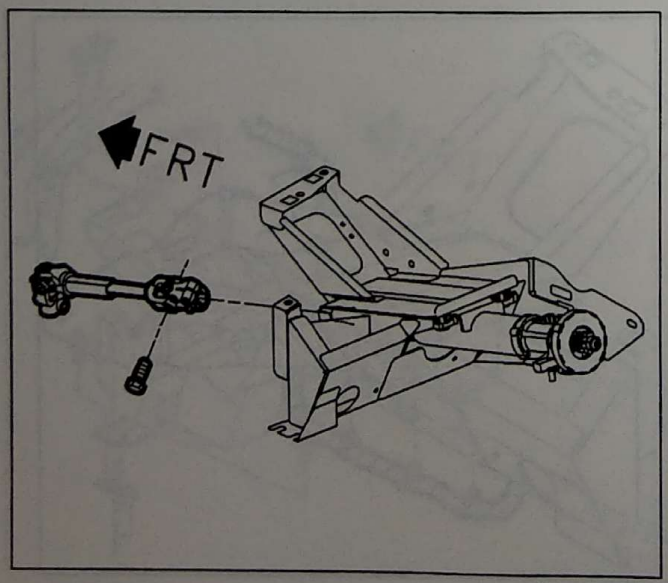
PSMVIS66718AA

16. Load steering column into steering column support aligning studs on support to base of steering column.
17. Start bolts at upper mount of steering column and hand tighten.
18. Install nuts at base of steering column.

Torque: 25 N•m (19 ft−lbs)

19. Tighten bolts at upper mount of steering column.

Torque: 25 N•m (19 ft−lbs)

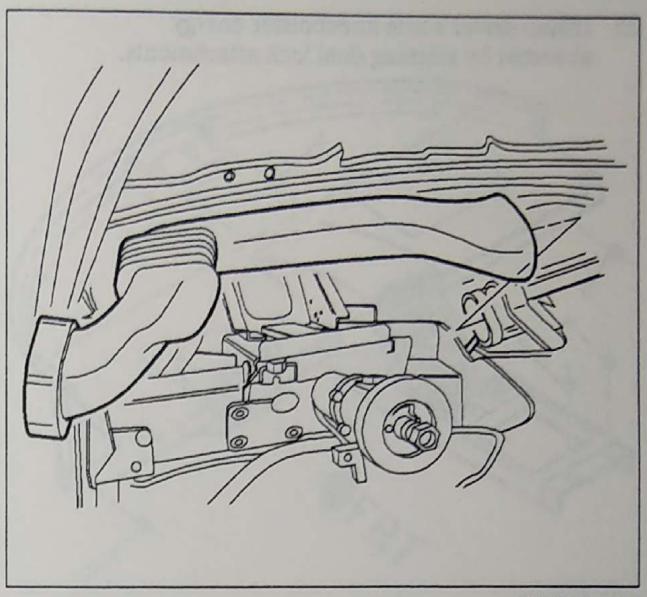


PSMVIS66790AA

20. Fit intermediate shaft to splined end of steering column and install bolt to intermediate shaft.

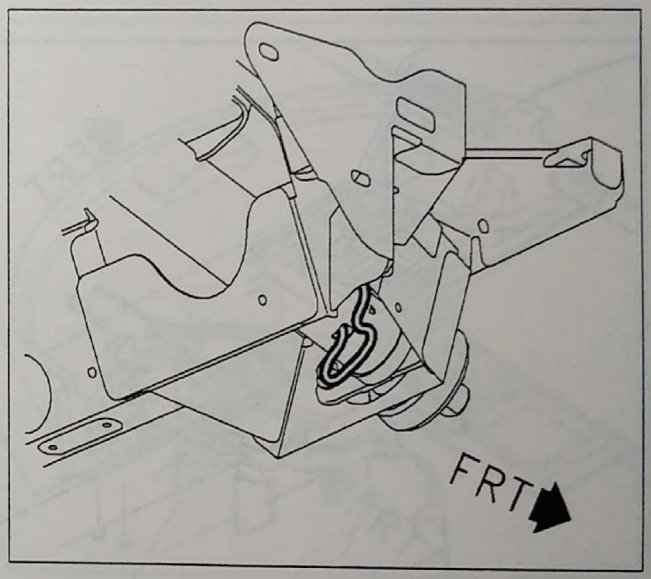
Torque: 47 N•m (35 ft−lbs)

21. Install driver side outer air duct.



PSMVIS66336AA

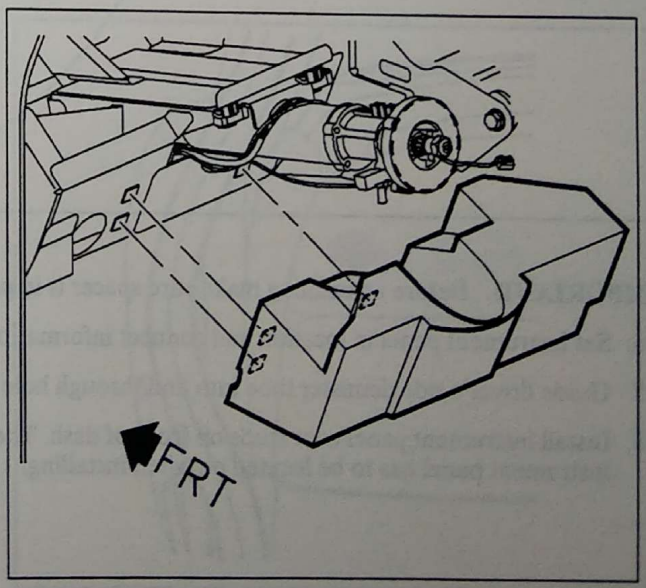
22. Remove anti-rotation clip from base of steering column.



PSMVIS66762AA

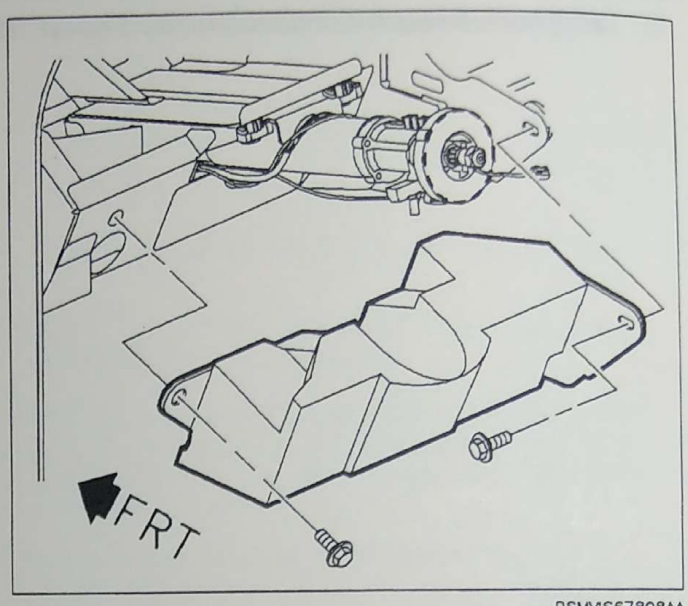
23. If driver's side knee bolster energy absorber is retained with bolts go to step 24. If energy absorber is retained with Dual-Lock, go to step 25.
24. Align driver's side knee bolster energy absorber and install bolts.

Torque: 25 N•m (19 ft−lbs)

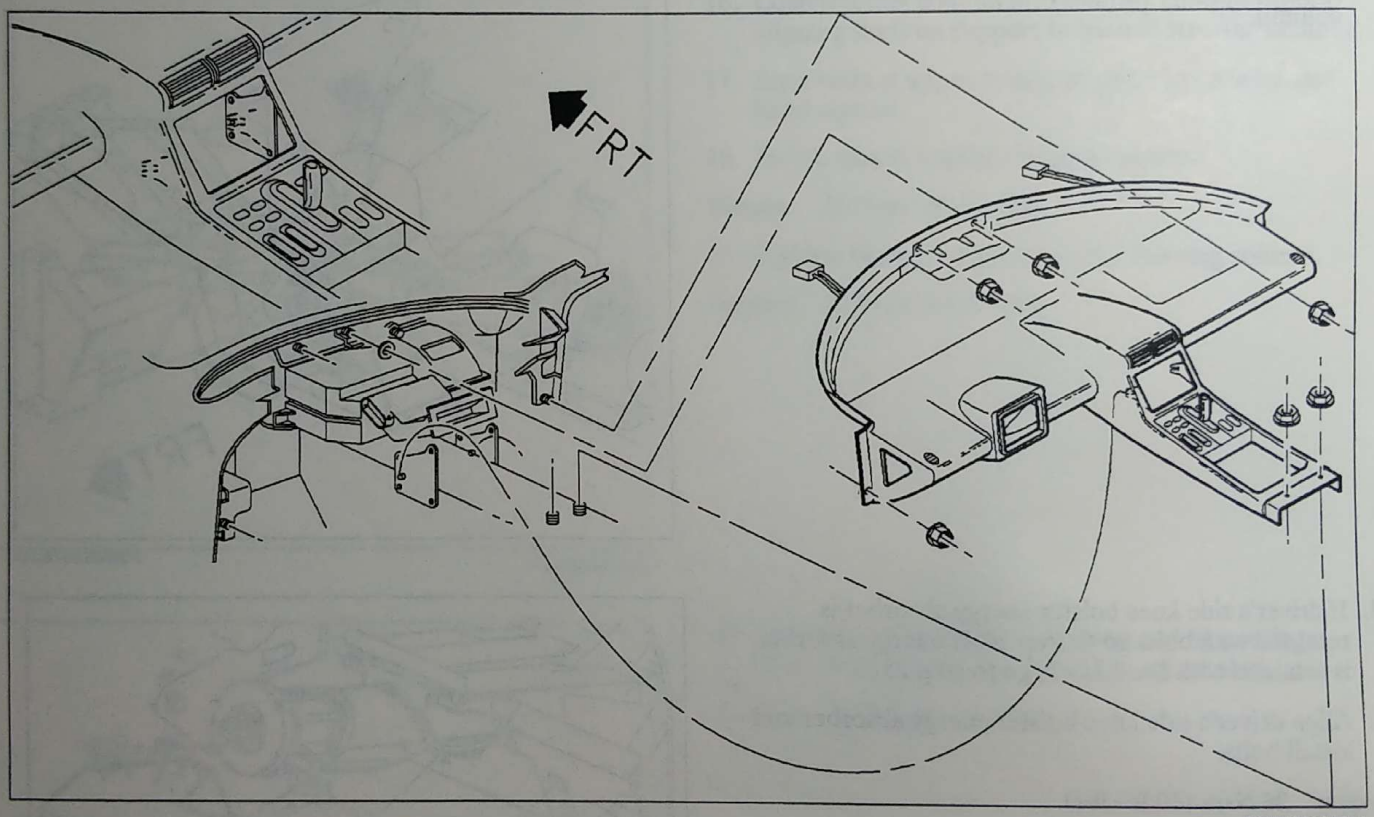


PSMVIS66338AA

25. Install driver's side kneebolster energy absorber by aligning dual lock attachments.



PSMVIS67898AA



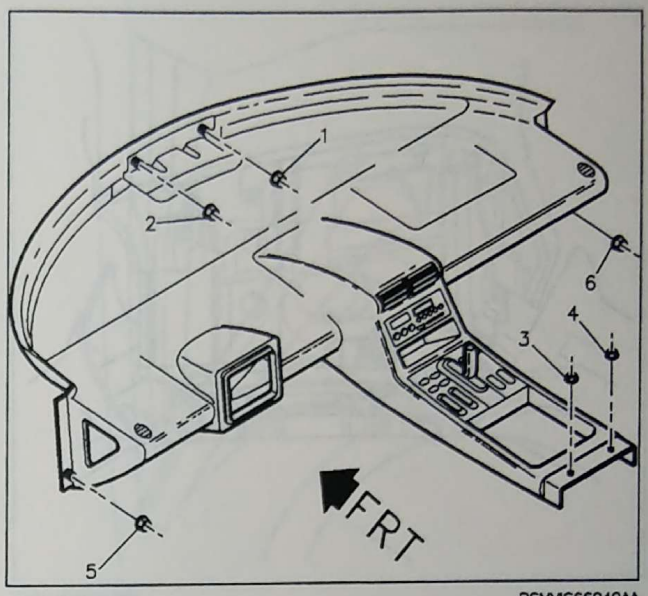
PSMVIS66048AA

IMPORTANT: Before assembling make sure spacer is in proper location to body. Refer to illustration.

26. Set instrument panel in location and connect information telltale connectors.
27. Guide driver's side demister tube into and through hole in steering column support.
28. Install instrument panel over studs on front of dash. The tunnel has locator pins on either side of which the instrument panel has to be located on when installing.

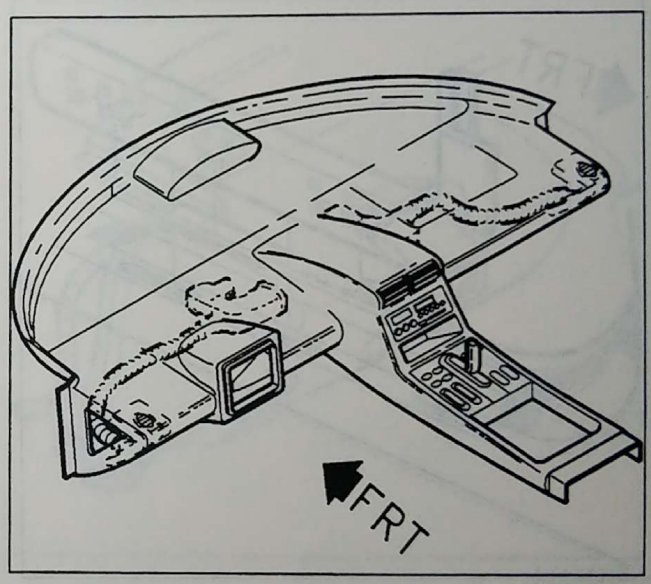
29. Secure instrument panel fasteners. Torque in sequence.

Torque: 5 N•m (44 in−lbs)



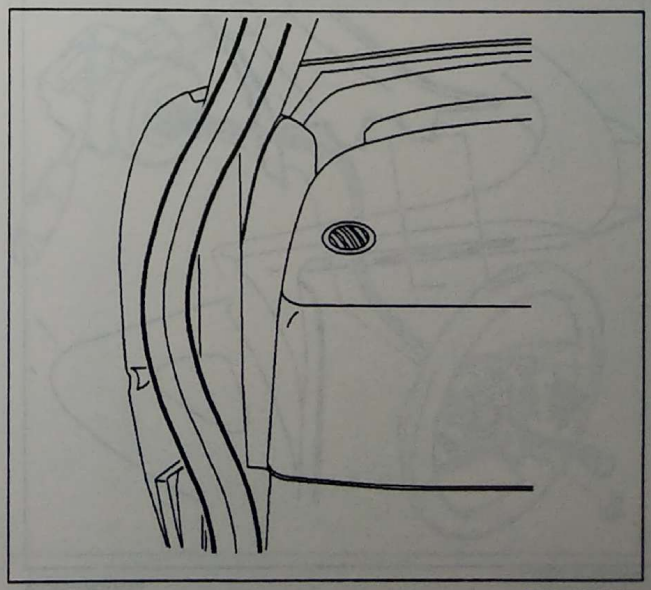
PSMVIS66049AA

30. Connect side window demister tubes to floor outlets.

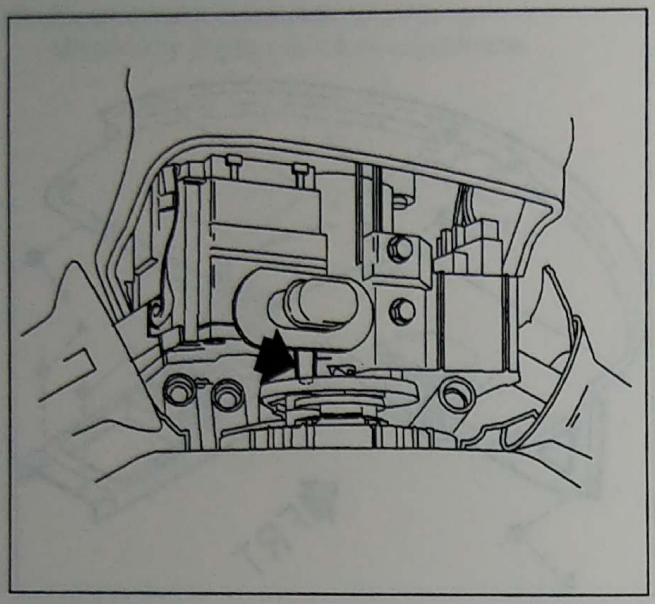


PSMVIS66047AA

31. Install side door weather strip onto pinch weld flange near Instrument panel.



PSMVIS66337AA



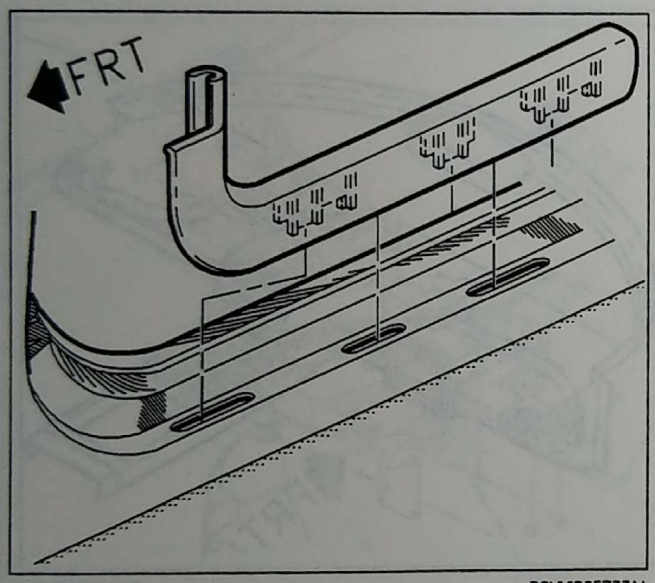
PSMELC66439AA

32. Connect connector to windshield washer switch.
33. Install screws retaining switch.

Torque: 2.5 N•m (22 in−lbs)

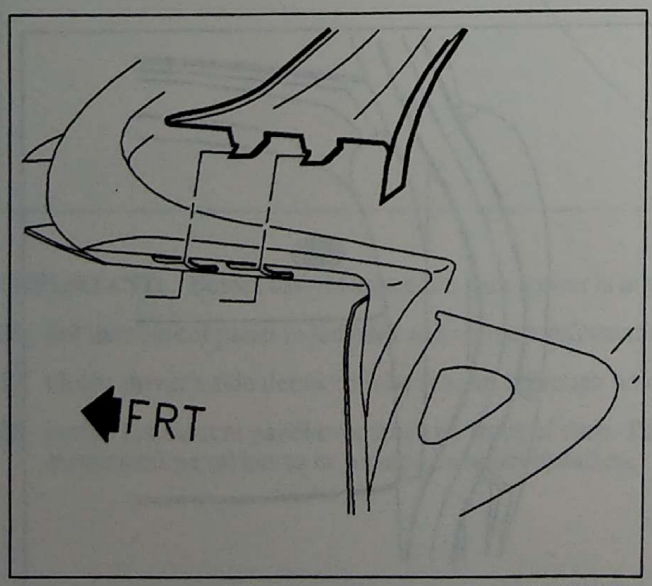
34. Connect three connectors to turn signal, headlamp, and cruise switch.
35. Place switch in position, being careful that the pin is positioned correctly against the ring on the back of the turn signal cancel cam assembly.
36. Install screws retaining switch.

Torque: 2.5 N•m (22 in−lbs)



PSMMS65733AA

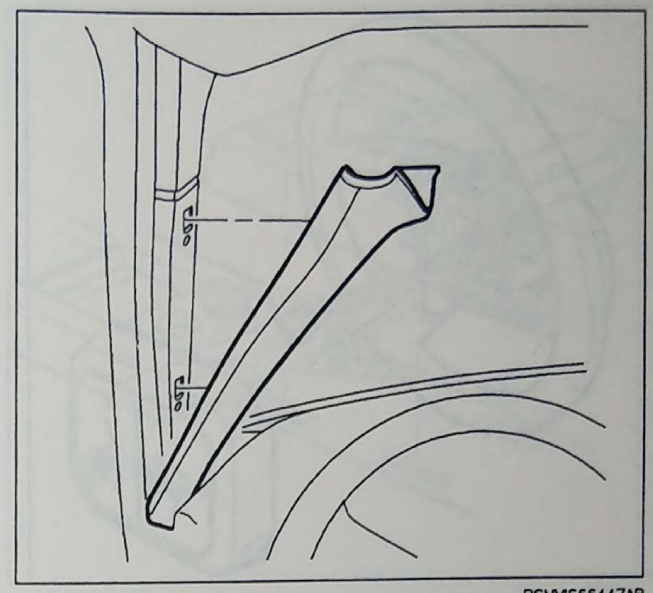
37. Locate carpet retainer to door opening.
38. Firmly seat carpet retainer into weather.
39. Snap clips into slots in inner rocker pan.



PSMMS66448AA

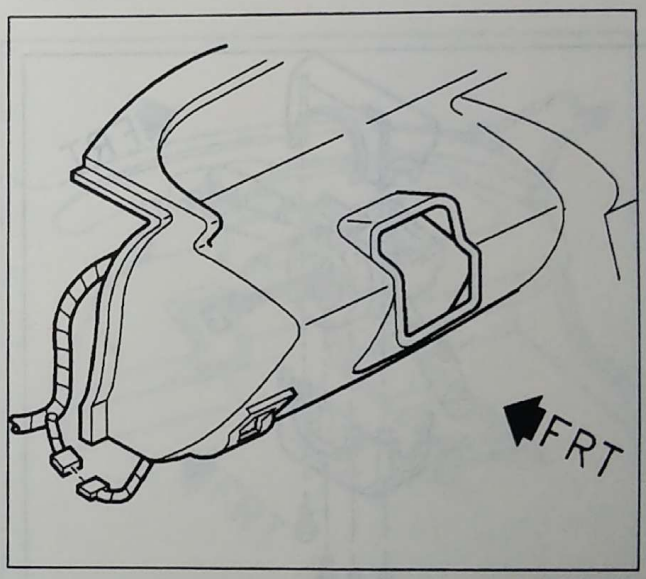
40. Insert tabs on bottom of garnish molding into instrument panel.
41. Push molding downward and forward past A-pillar structure.

42. Push molding to structure pressing forward and outward to insure proper fit to instrument panel, headlining and door seal.
43. Align clips on garnish molding to slots in A-pillar and press firmly at clip locations.
44. Position flap on door weatherstrip over windshield garnish molding.



PSMMS66447AB

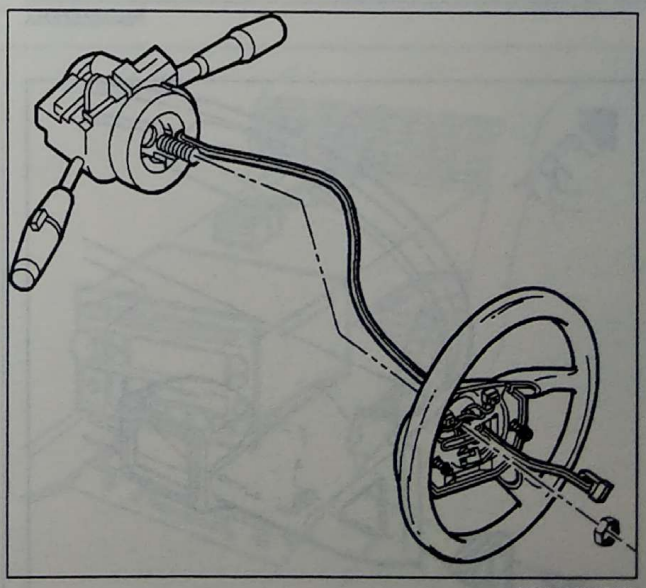
45. Connect park brake switch connector.



PSMMS65865AA

46. Route SIR cable through steering wheel. Install steering wheel to column.
47. Connect horn wire connector.
48. Install steering wheel nut.

Torque: 42 N•m (31 ft−lbs)



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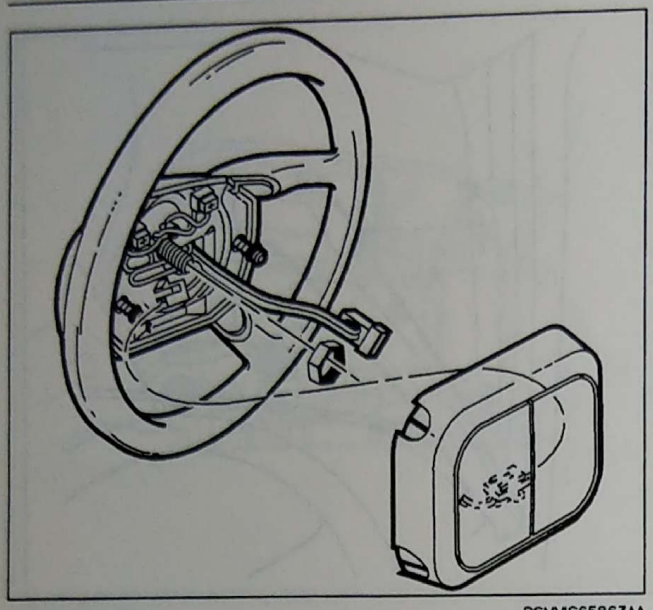
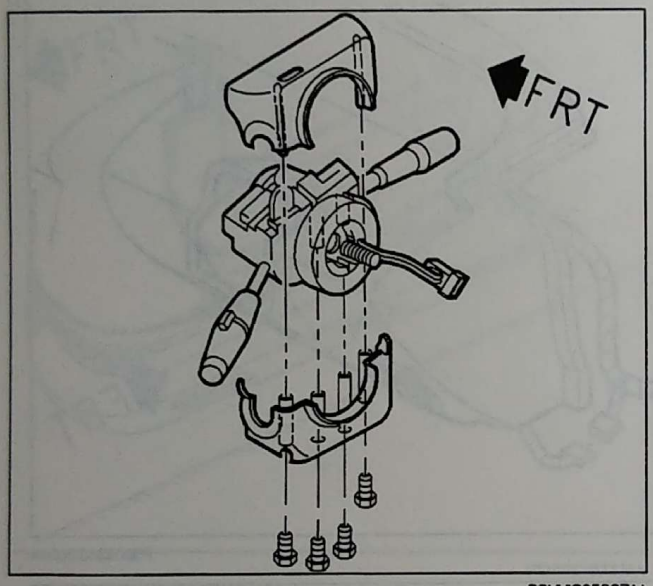


PSMIS65863AA

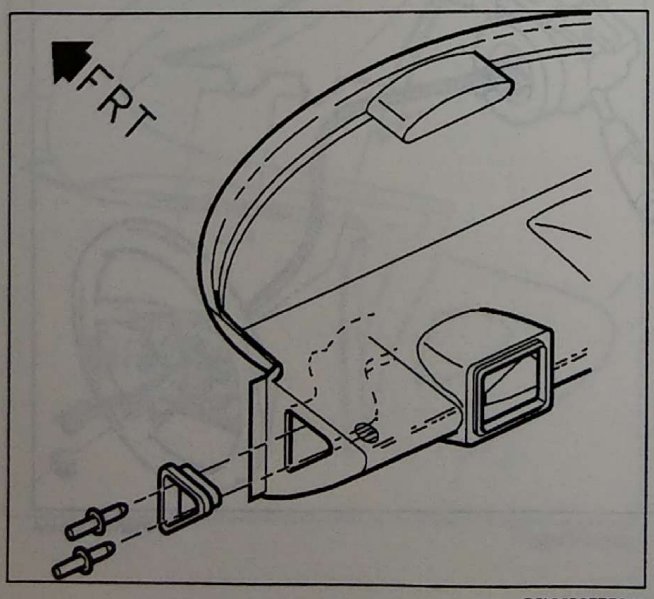
49. Route yellow SIR inflator module wire harness within the steering wheel hub forming an "S" shape with wire and connect SIR inflator module connector.
50. Install CPA to connector.
51. Install inflator module to steering wheel.

Torque: 10 N•m (7 ft−lbs)



PSMIS65827AA

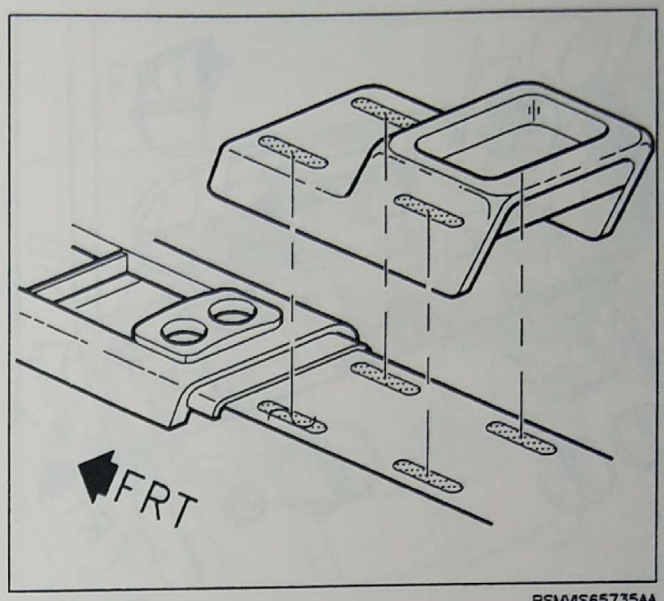
52. Align lower steering column trim cover to steering column. Install and tighten inner screws.
53. Align upper steering column trim panel to steering column and install outer screws in lower steering column trim panel. Tighten outer screws.



PSMIS65736AA

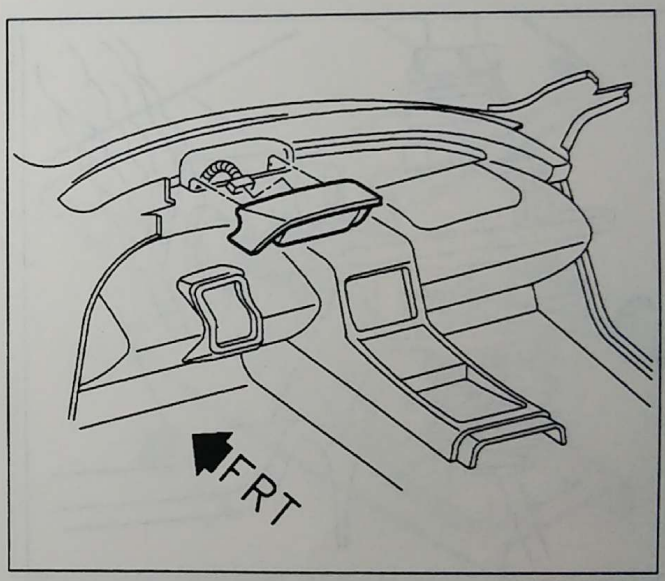
54. Install left and right front side door air outlets on side of the instrument panel using new fasteners.

55. Install arm rest



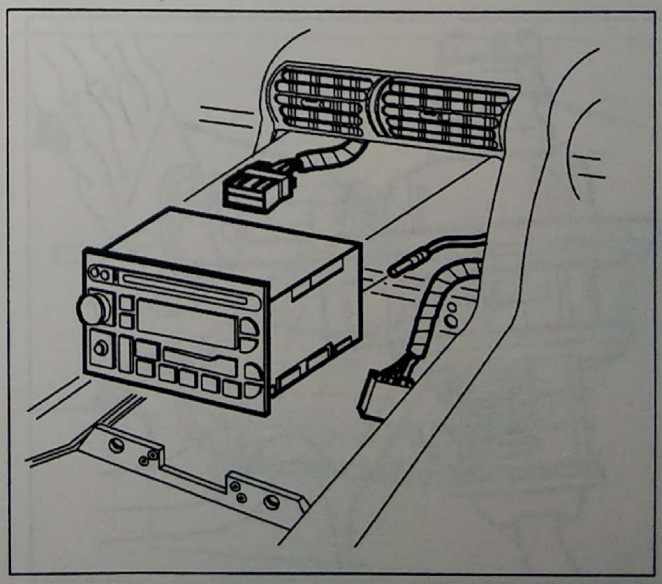
PSMMS65735AA

56. Push harness connector into socket on instrument panel cluster. Verify connection is made, seated and locked.
57. Install instrument panel cluster into instrument panel by pushing forward and downward.



PSMELC66359AA

58. Connect radio harness to radio, then antenna lead to radio. Verify both connectons are seated properly.
59. Make sure antenna and harness are up and out of the way of the radio bracket. Slide radio into opening until the radio is seated and the radio fits tightly to the console. You may hear a click as the radio tab locks into the bracket.



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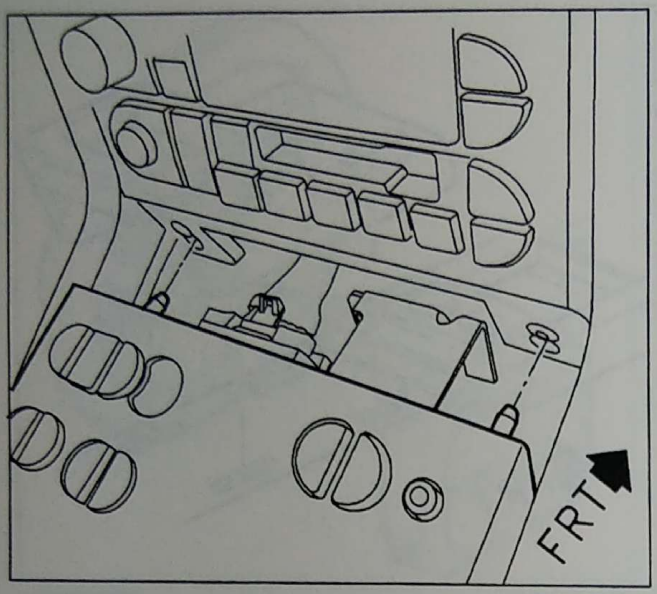
CamScanner



PSMELC66360AA

60. Cover the radio face with a rag for protection during RSA installation. Install shift cable housing into shift bracket and connect and secure shift cable to shifter. Be sure clip lock tab is in place.
61. Connect wire harness connector to RSA.
62. Align RSA locator tabs to front of instrument panel and push down on the rear of the RSA.
63. Install TORX™ fasteners.

Torque: 6 N•m (53 in−lbs)

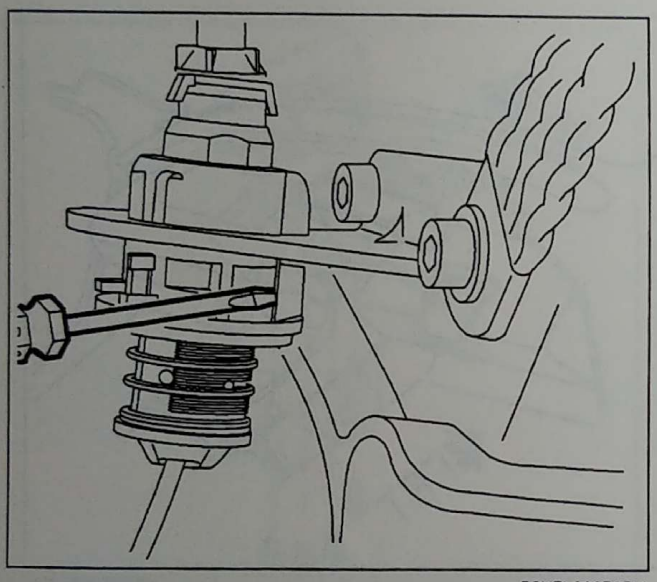
IMPORTANT: You must adjust shift cable at final drive unit.

64. Adjust shift cable.

IMPORTANT: The shift cable must be attached to the RSA with the RSA secured in position. Shift handle must be placed in neutral before cable adjustment can be performed.

a. Remove underbody front air deflector assembly. (Refer to "Underbody Front Air Deflector Assembly" in this manual.)

b. Unlock U-shaped adjustment collar. Collar is located aft of drive unit bracket, and will unlock by inserting a pocket screwdriver into gap and prying towards drive unit.



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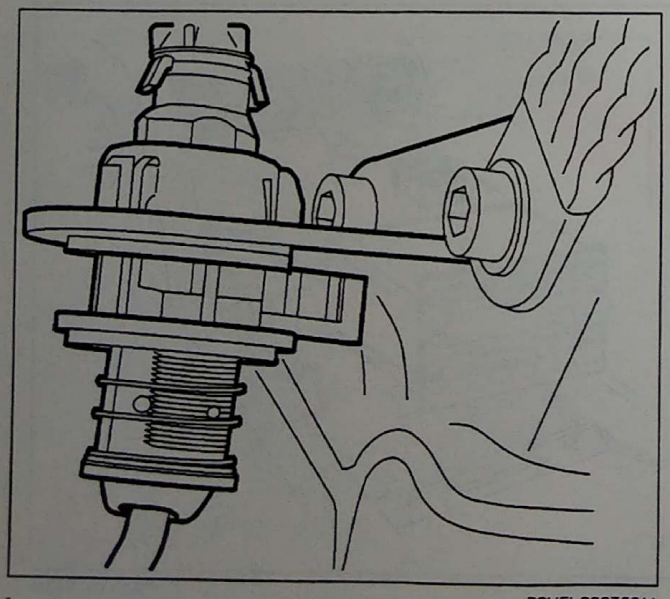

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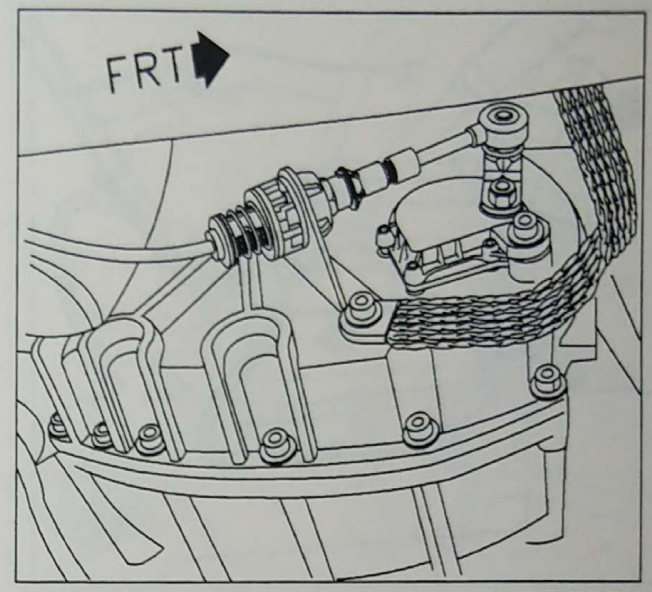
IMPORTANT: About 1/2 inch movement necessary to insure unlock position.

c. Verify shift lever is in neutral. Push U-shaped collar into lock position. Collar will move to right side of vehicle.

d. By hand shift park/lock lever to the full counter-clockwise position (DRIVE) then move one detent in the clockwise direction (NEUTRAL).

e. Install underbody front air deflector assembly. (Refer to "Underbody Front Air Deflector Assembly" in this manual.)

NOTICE: If shift cable has been removed more than six times at either end, for any reason, the cable must be replaced.



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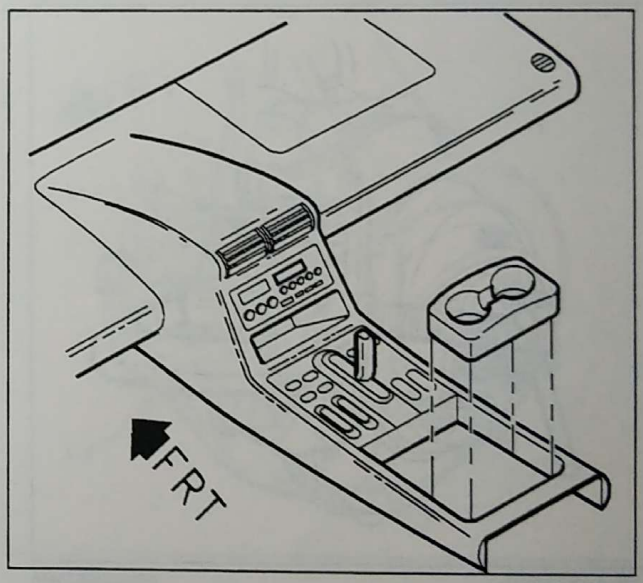
65. Install cup holder to center console.

66. Enable the SIR system. (Refer to "Enabling the SIR System" in this manual.



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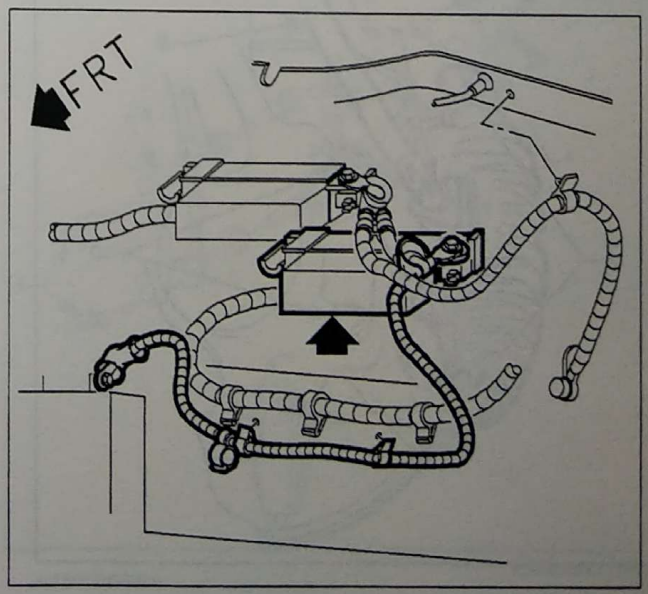
67. Install Turn/Modules maxi fuse into lower maxi fuse block, located underhood between PEB and front of dash.



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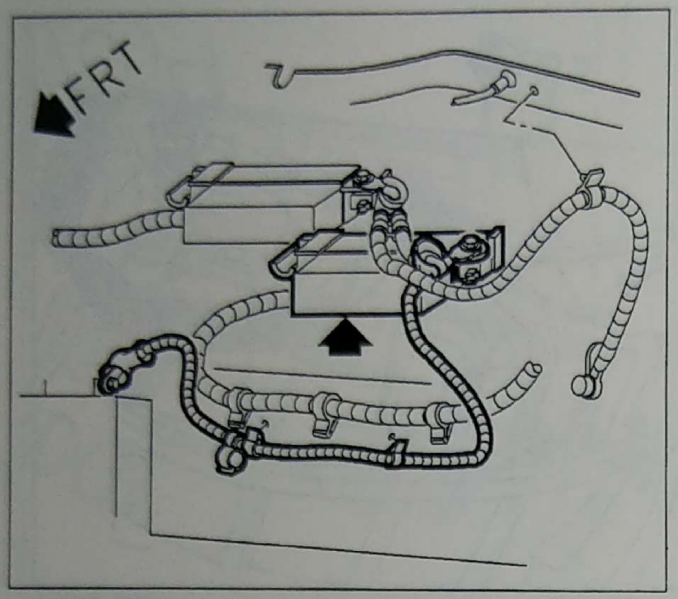

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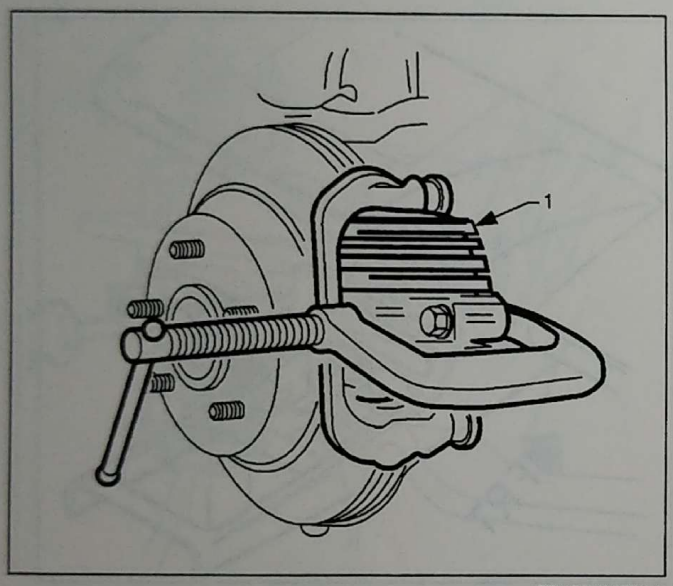

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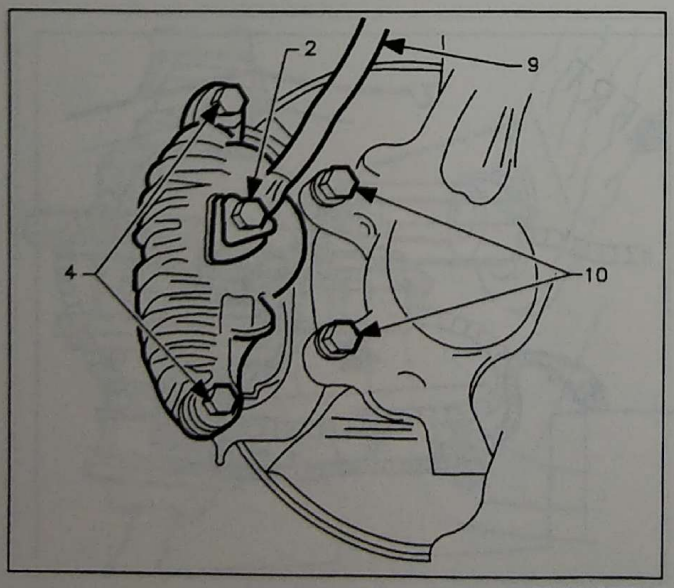

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FRONT DISC BRAKES

FRONT SHOE AND LININGS

REMOVAL

1. Remove two-thirds of the brake fluid from the master cylinder reservoir.

NOTICE: Brake fluid will damage painted surfaces. Shop cloths and clean containers should be used to prevent spillage of brake fluid.

2. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.
3. Raise vehicle on hoist (Refer to "Lifting, Jacking, and Support Points" in this manual.)
4. Remove front road wheels.
5. Position a C-clamp on caliper (1) and tighten until caliper piston bottoms in bore.

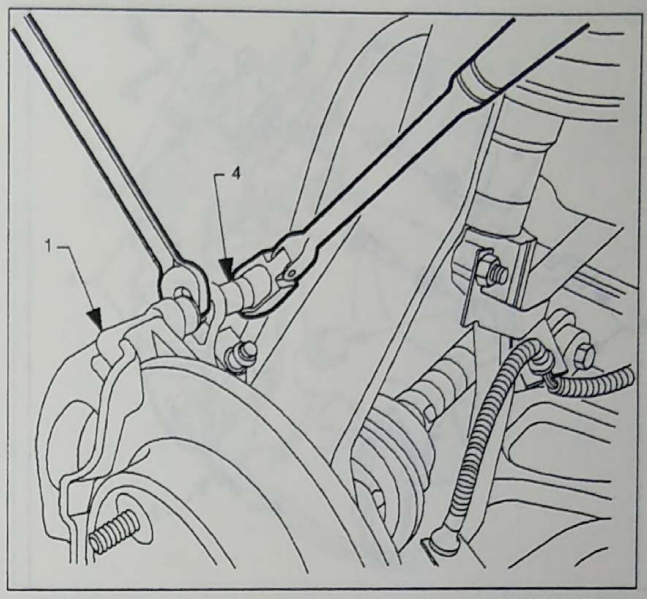
IMPORTANT: Make sure one end of C-clamp rests on inlet fitting (2) bolt head and the other against the outboard pad.

6. Remove upper caliper bolt (4). Rotate/pivot caliper around lower caliper bolt (4), to expose the front brake pads (3) and (5). Discard upper caliper bolt (4).
7. Remove shoe and lining assemblies (3) and (5) from mounting bracket (6).
8. Remove H-shims (7) and abutment shims (8).

IMPORTANT: Clean corrosion and or residue from pad abutments on mounting bracket and from the inside of the housing outer legs.

IMPORTANT: Inspect guide pins for free movement in bracket. Replace guide pins or guide pin boots if corroded or deteriorated.

9. Repeat steps 5 thru 8 for opposite side.



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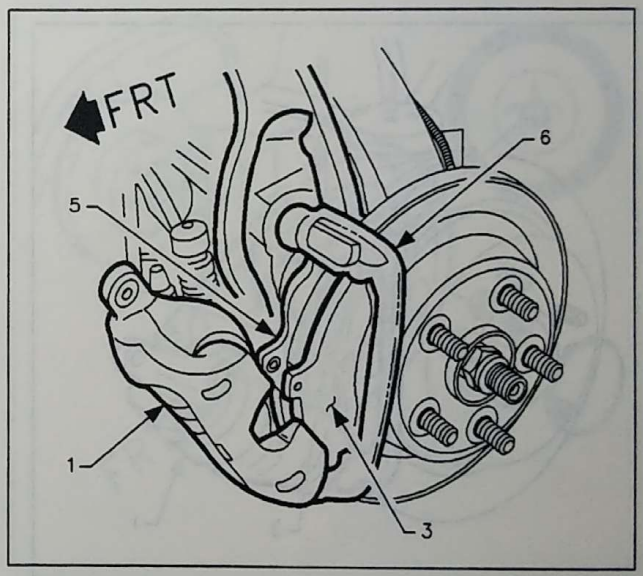

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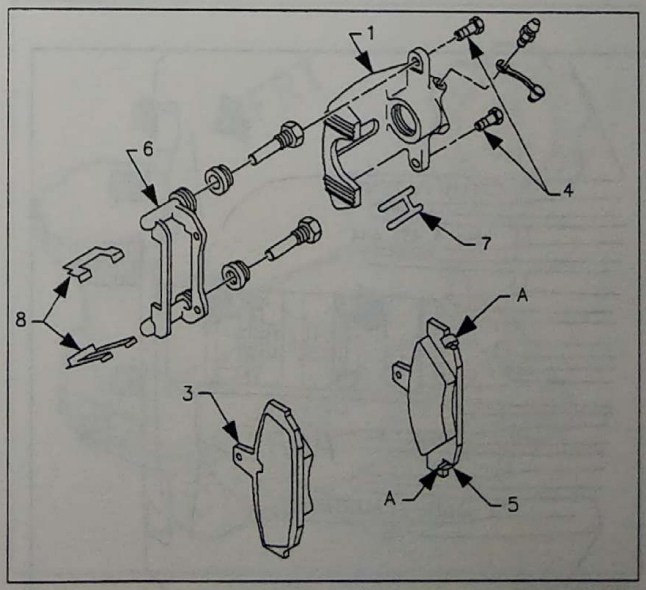

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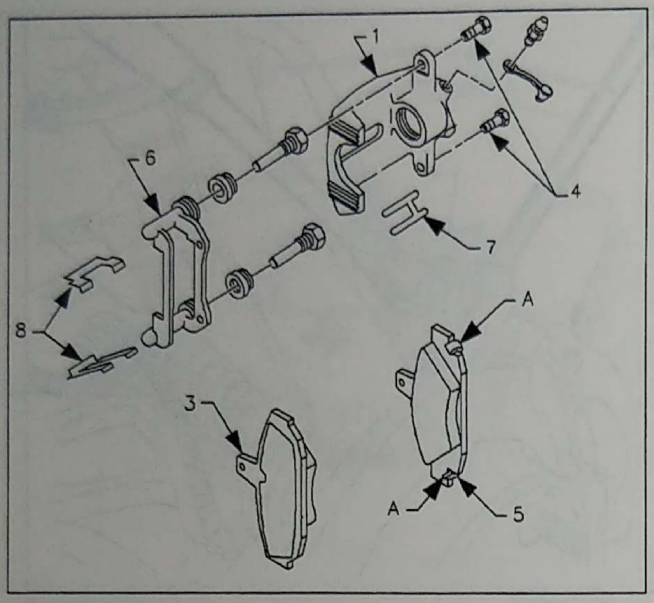

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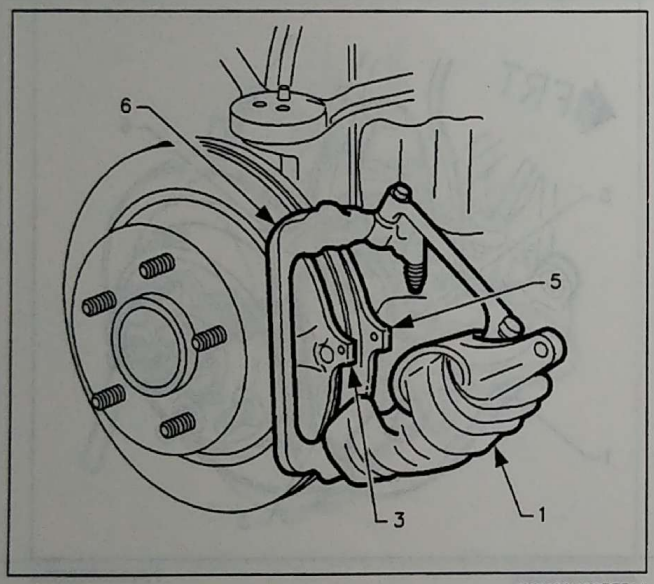

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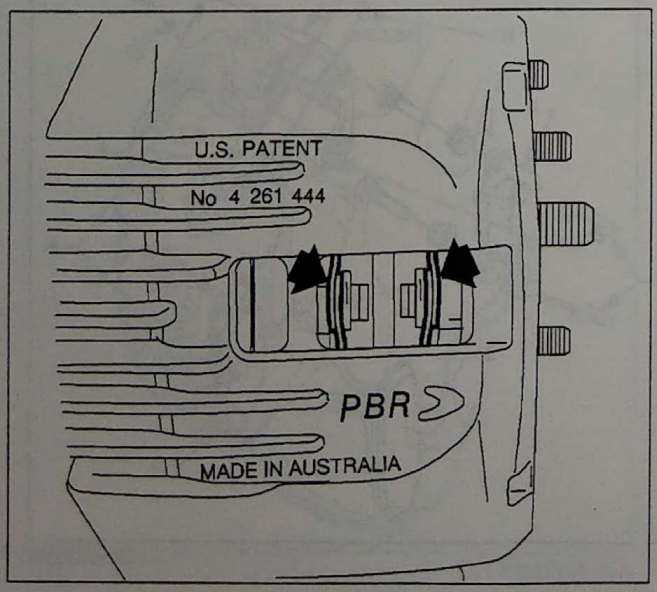


PSMGCH66798AB

INSTALLATION

IMPORTANT: Electric Vehicle (or equivalent) replacement brake lining material is recommended for this vehicle to maintain the balance between the front and rear brake performance. Electric Vehicle (or equivalent) replacement brake parts have been carefully selected to provide the proper brake balance for the purpose of stopping distance and control over the full range of operating conditions. Installation of front or rear brake lining material with performance characteristics different from the recommended Electric Vehicle (or equivalent) replacement parts can change the intended brake balance for this vehicle.

IMPORTANT: Never replace brake shoe and linings on one side of axle only. Left and right side brake shoe and linings must be replaced only as axle sets.

1. Install H-shim (7) into caliper body (1) and abutment shims (8) on mounting bracket (6).

IMPORTANT: Install H-shim (7) with short side of H-shim towards caliper piston. Shoe and lining assembly (3) with insulator is installed OUTBOARD. Shoe and lining assembly (5) with wear sensor (A) is installed INBOARD.

IMPORTANT: Remove all rust and corrosion from the caliper bracket and abutment shim (8) when installing brake shoe and linings. If installing used brakes shoe and linings, remove all rust and corrosion. Make sure the brake shoe and linings move freely in the caliper brackets when the brakes are assembled.

2. Install shoe and lining assemblies (5) and (3) on mounting bracket (6).

IMPORTANT: Take care NOT to deform H-shim when installing shoe and lining assemblies.

3. Rotate caliper (1) back into the operating position. Inspect the shoe springs. If they are protruding through the inspection hole, rotate the caliper and readjust.

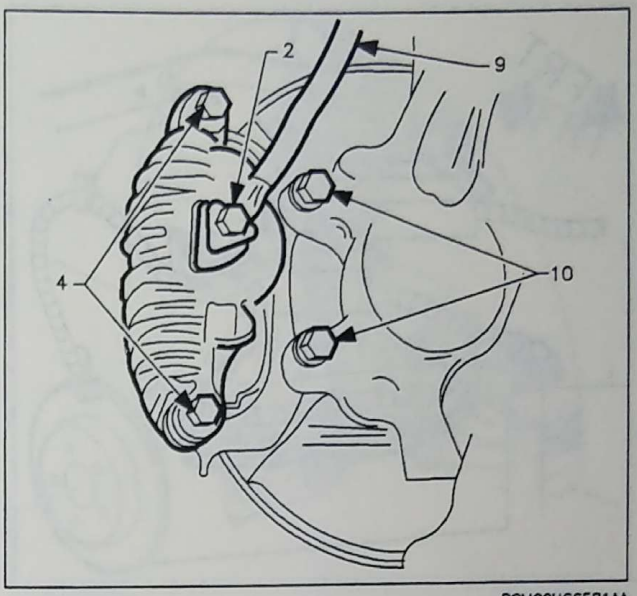
4. Install new bolt (4).

Torque: 32 N•m (24 ft−lbs)

5. Position wheel on hub.
6. Install wheel lug nuts and tighten in a star pattern. Repeat tightening pattern to make sure torque is correct.

Torque: 120 N•m (89 ft−lbs)

7. Repeat steps 1 thru 6 for the opposite side.
8. Lower vehicle from hoist.
9. Fill brake fluid reservoir with clean brake fluid up to the proper level.
10. Install Turn/Modules maxi fuse into lower maxi fuse block, located underhood between PEB and front of dash.



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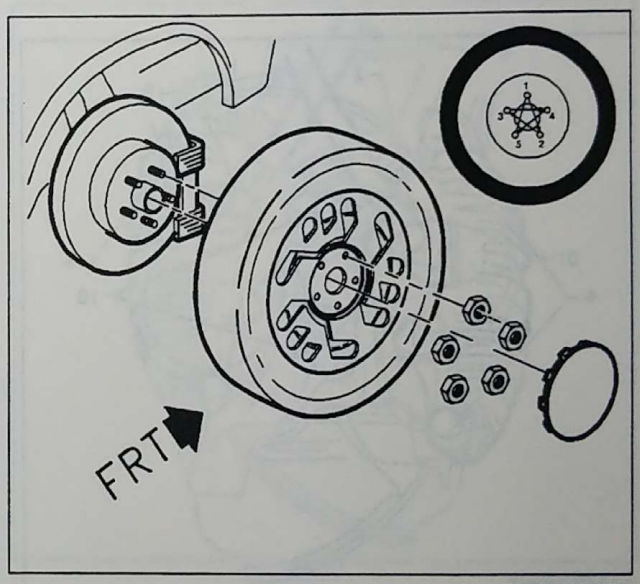
IMPORTANT: Use only Delco Supreme 11, DOT 3 brake fluid P/N 12377967 (or equivalent) from a clean sealed container.

IMPORTANT: Be sure the master cylinder reservoir cap is installed before the brake pedal is depressed. This prevents brake fluid from spraying from the reservoir.

11. Put vehicle in RUN mode.
12. Pump brake pedal firmly and slowly three times to bring shoe and lining assemblies into contact with rotors.

IMPORTANT: Remove foot from brake pedal between applies and wait one second between applications.



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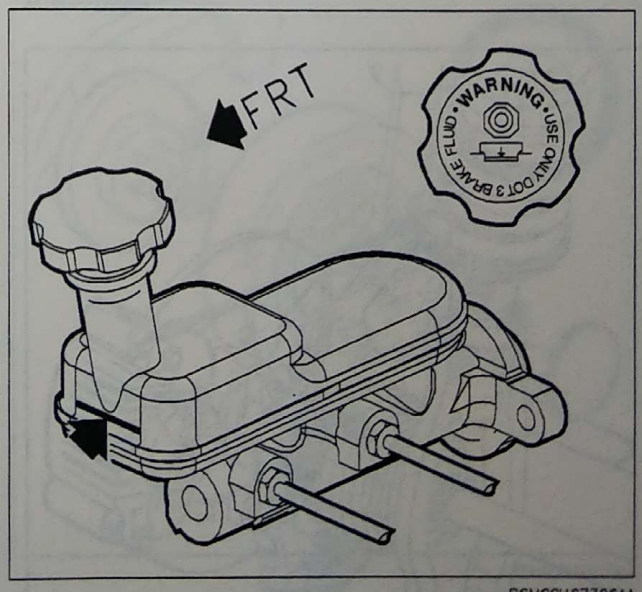
IMPORTANT: Check for codes. If code(s) 51 or 54 are set, clear code(s). Recheck brake system operation.

13. Fill brake fluid reservoir with clean brake fluid up to the proper level.
14. Road test vehicle.



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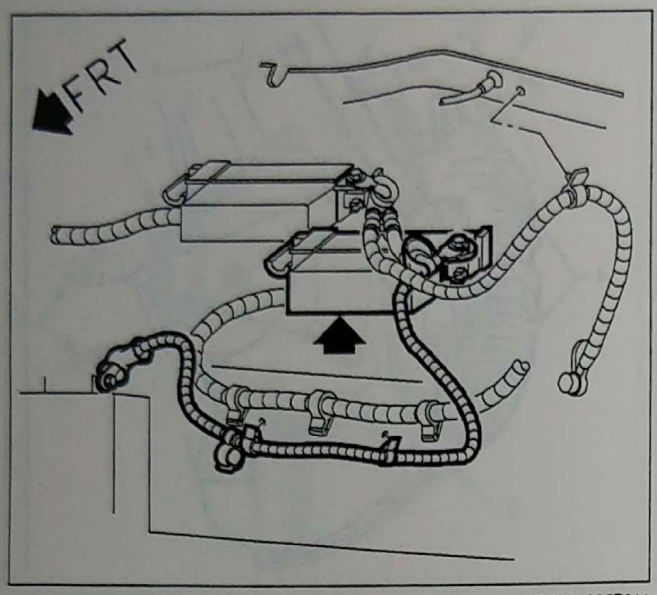
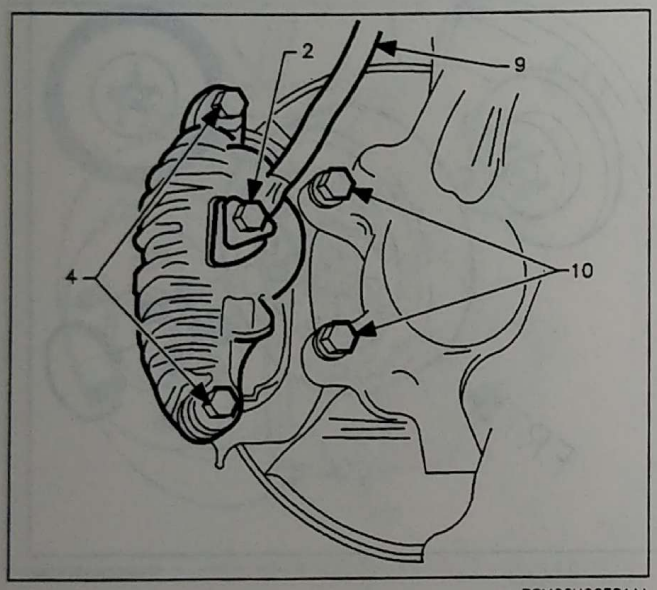


PSMGCH66679AA

FRONT ROTOR

REMOVAL

1. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.
2. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
3. Remove road wheel corresponding to rotor being removed.



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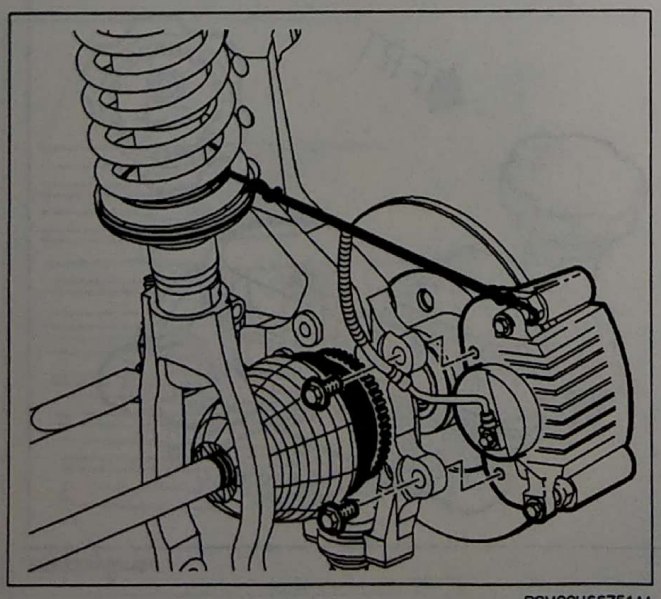
4. Remove bolts (10) securing front caliper and bracket to steering knuckle.



PSMGCH66751AA

5. Remove caliper assembly and suspend it from the shock spring with safety wire.

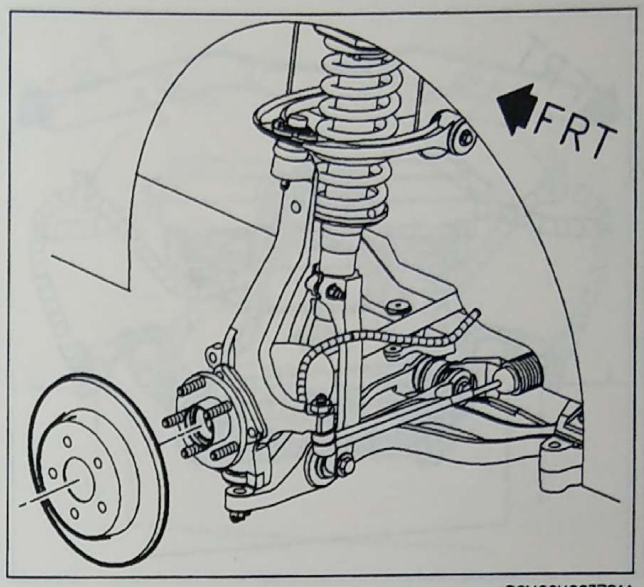
6. Remove front rotor.

FRONT ROTOR THICKNESS

New (nominal):	11.0 mm (0.44 in)
Minimum Thickness After Refinish	9.3 mm (0.37 in)
Discard Thickness	9.0 mm (0.35 in)

IMPORTANT: Brake rotors have a discard diameter or thickness dimension cast into them. This is a wear dimension and not a refinish dimension. Any rotor which does not meet the specification should be discarded.

IMPORTANT: Refer to "Inspecting and Refinishing Brake Rotors" in the "Diagnosis and Inspection" section in this service manual.



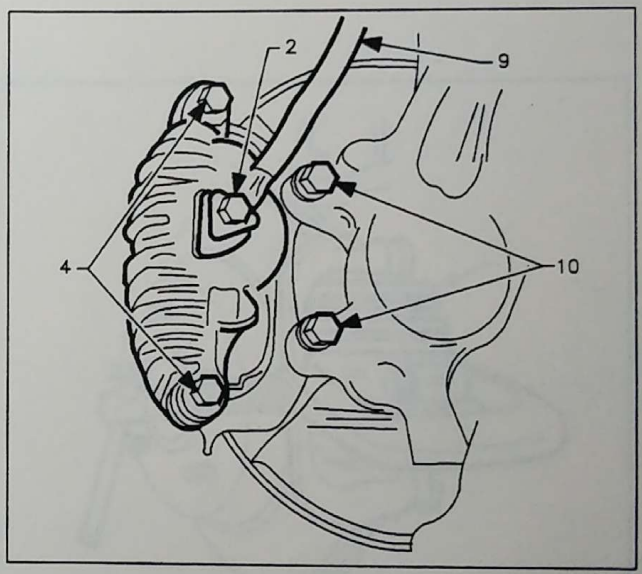
PSMGCH66372AA

INSTALLATION

IMPORTANT: Clean corrosion from mating surfaces of rotor and wheel hub.

1. Install front rotor onto front wheel hub.
2. Install front caliper assemble.
3. Install bolts (10) securing front caliper assembly and bracket to steering knuckle.

Torque: 110 N•m (81 ft−lbs)



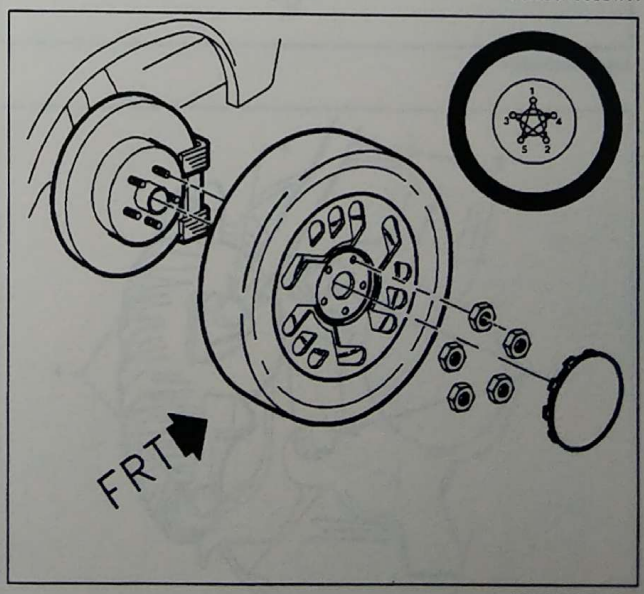
PSMGCH66581AA

NOTICE: Before installing wheels, remove rust or corrosion from wheel mounting surfaces and brake rotors. Failure to do so can cause wheel lug nuts to loosen in service.

4. Position wheel on hub.
5. Install wheel lug nuts and tighten in a star pattern. Repeat tightening pattern to make sure torque is correct.

Torque: 120 N•m (89 ft−lbs)

6. Lower vehicle from hoist



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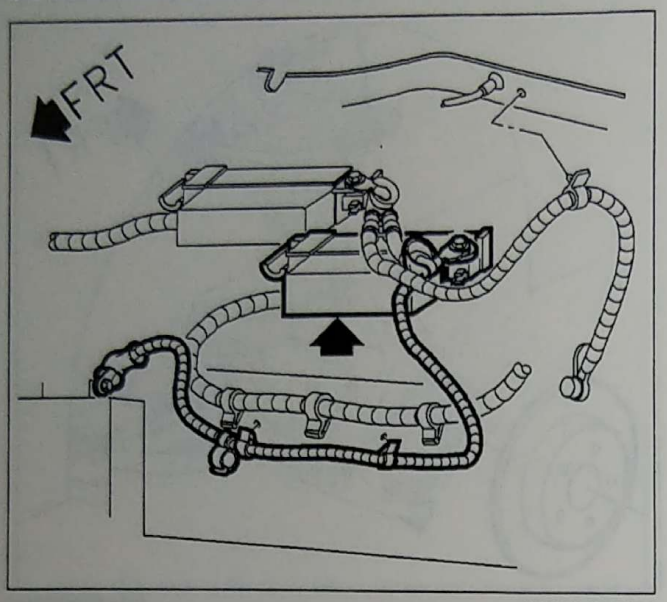

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7. Install Turn/Modules maxi fuse into lower maxi fuse block, located underhood between PEB and front of dash.

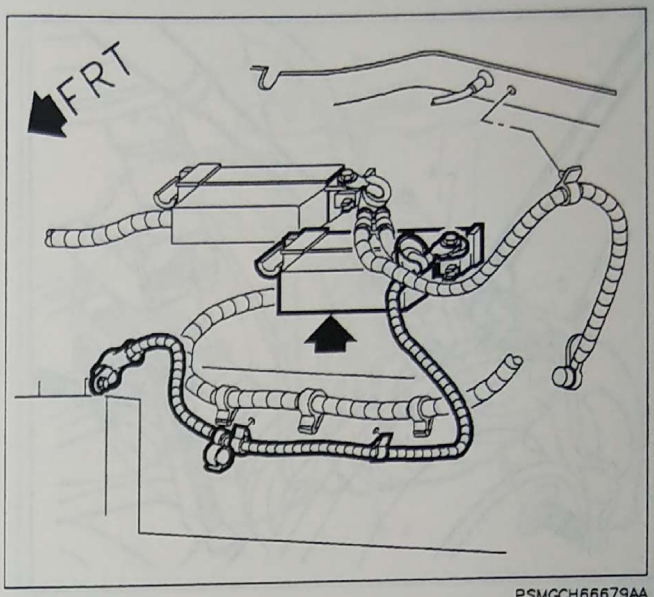
FRONT CALIPER

REMOVAL

1. Remove two-thirds of the brake fluid from the master cylinder reservoir.

NOTICE: Brake fluid will damage painted surfaces. Shop cloths and clean containers should be used to prevent spillage of brake fluid.

2. Remove Turn/Modules maxi fuse from lower maxi fuse block, located underhood between PEB and front of dash.
3. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
4. Remove road wheel corresponding to caliper being removed.
5. Install two wheel nuts to retain rotor.



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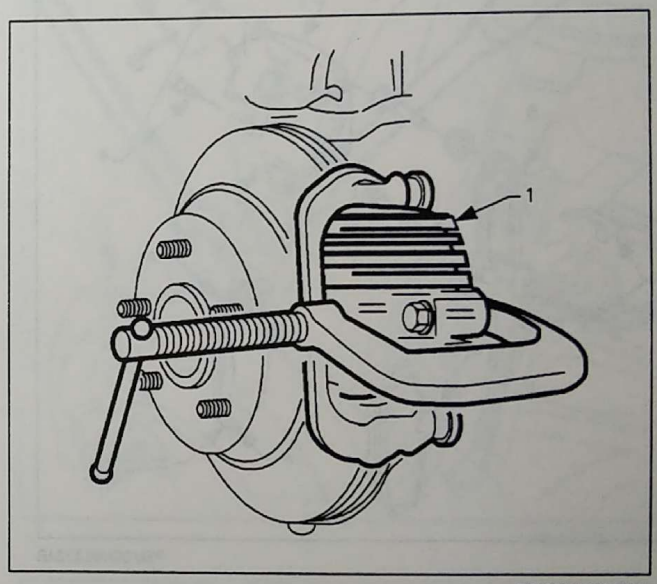
6. Position a C-clamp on caliper (1) and tighten until caliper piston bottoms in bore.



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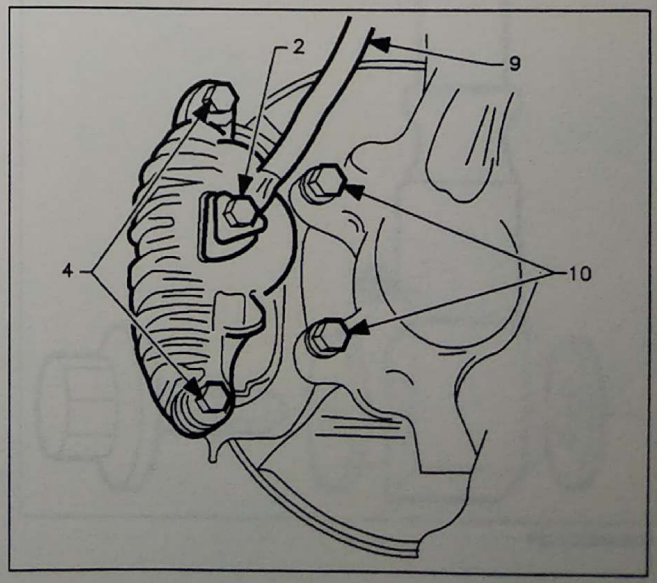
IMPORTANT: Make sure one end of C-clamp rests on inlet fitting (2) bolt head and the other against the outboard pad (3).

7. Disconnect inlet fitting (2) and washers.
8. Plug hose to prevent entrance of contaminants.

IMPORTANT: Do not remove bracket bolts (10).



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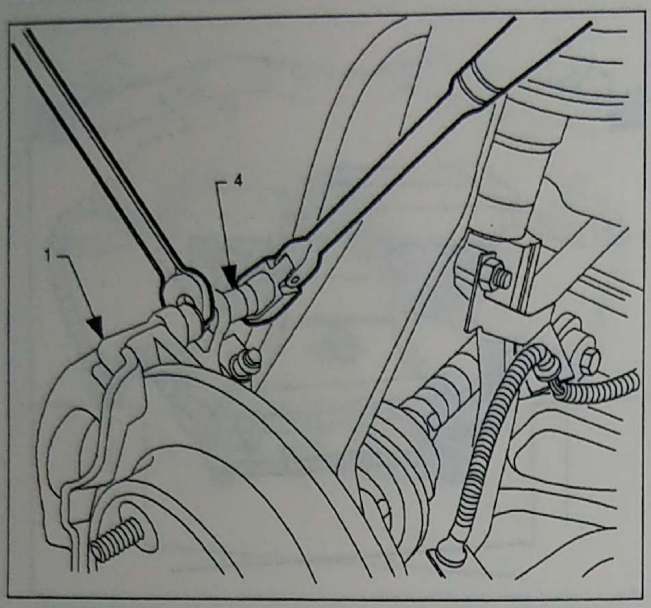
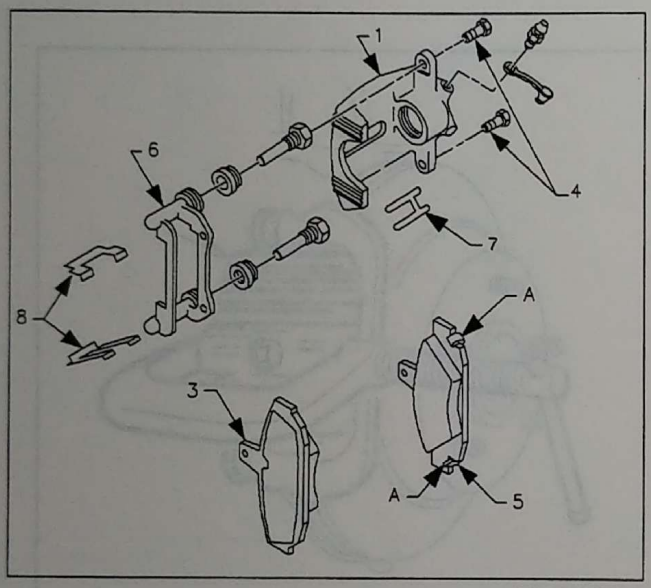


PSMGCH66796AB

9. Remove bolts (4).
10. Remove caliper (1) from vehicle.

IMPORTANT: Clean corrosion and or residue from pad abutments on mounting bracket and from the inside of the housing outer legs.

IMPORTANT: Inspect guide pins for free movement in bracket. Replace guide pins or guide pin boots if corroded or deteriorated.



PSMGCH66333AB

INSTALLATION

1. Make sure caliper piston is bottomed fully in its caliper bore.

IMPORTANT: Electric Vehicle (or equivalent) replacement brake lining material is recommended for this vehicle to maintain the balance between the front and rear brake performance. Electric Vehicle (or equivalent) replacement brake parts have been carefully selected to provide the proper brake balance for the purpose of stopping distance and control over the full range of operating conditions. Installation of front or rear brake lining material with performance characteristics different from the recommended Electric Vehicle (or equivalent) replacement parts can change the intended brake balance for this vehicle.

IMPORTANT: Never replace brake shoe and linings on one side of axle only. Left and right side brake shoe and linings must be replaced only as axle sets.

2. Install H-shim (7) into caliper body (1) and abutment shims (8) on mounting bracket (6).

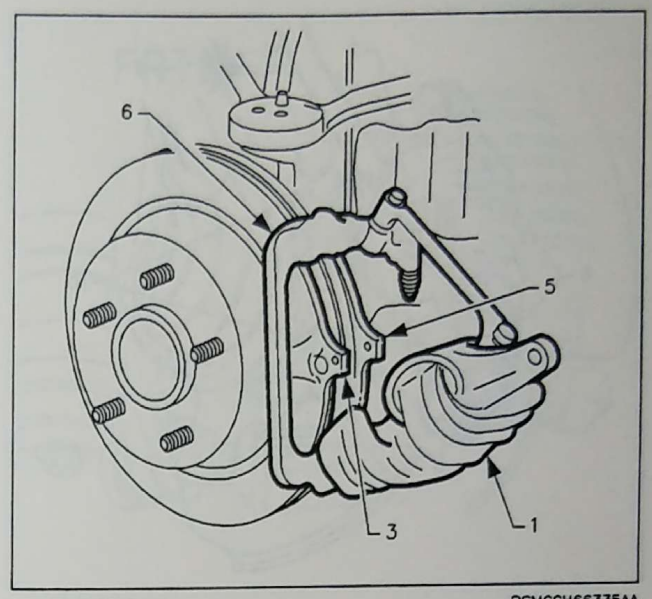
IMPORTANT: Install H-shim (7) with short side of H towards caliper piston. Shoe and lining assembly (3) with insulator is installed OUTBOARD. Shoe and lining assembly (5) with wear sensor (A) is installed INBOARD.

IMPORTANT: Remove all rust and corrosion from the caliper bracket and abutment shim (8) when installing brake shoe and linings. If installing used brakes shoe and linings, remove all rust and corrosion. Make sure the brake shoe and linings move freely in the caliper brackets when the brakes are assembled.

CamScanner

3. Install shoe and lining assemblies (5) and (3) on mounting bracket (6).

IMPORTANT: Take care NOT to deform H-shim when installing shoe and lining assemblies.



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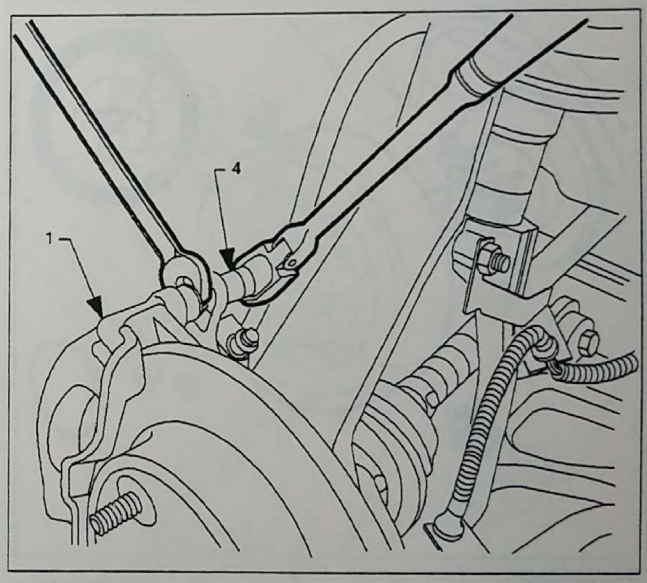
4. Install caliper (1) with two new bolts (4).

Torque: 31 N•m (23 ft−lbs)



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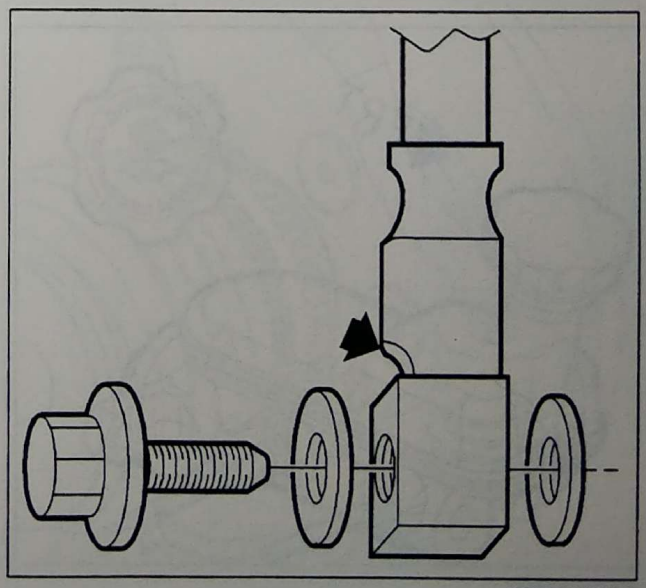
NOTICE: Attach brake hose to caliper with notch in hose fitting facing towards fastener. (Refer to illustration.)



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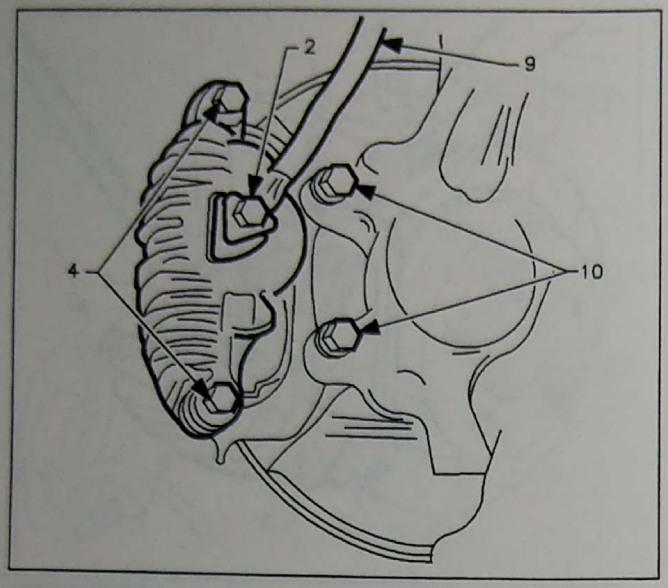
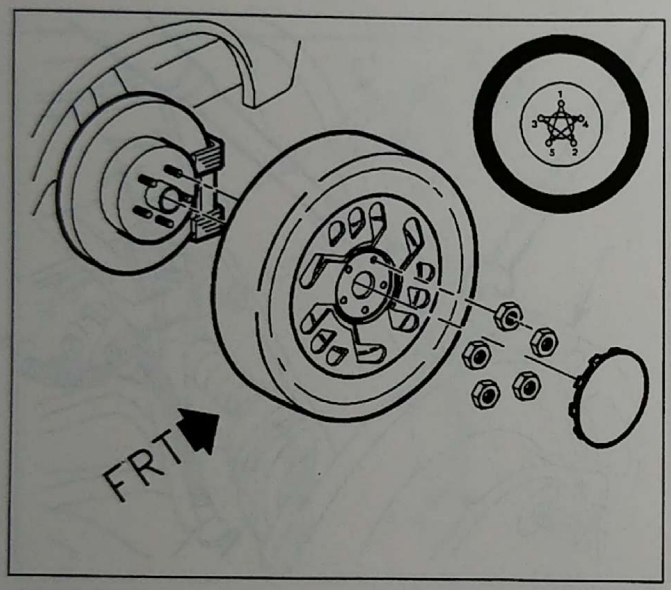


PSMGCH66581AA

5. Connect inlet fitting (2) with two washers.

Torque: 40 N•m (30 ft−lbs)

IMPORTANT: Be sure that front brake hose is routed correctly. Be careful not to install front brake hose with a twist.



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NOTICE: Before installing wheels, remove rust or corrosion from wheel mounting surfaces and brake rotors. Failure to do so can cause wheel lug nuts to loosen in service.

6. Position wheel on hub.
7. Install wheel lug nuts and tighten in a star pattern. Repeat tightening pattern to make sure torque is correct.

Torque: 120 N•m (89 ft−lbs)

8. Lower vehicle from hoist.
9. Fill brake fluid reservoir with clean brake fluid up to the proper level.

IMPORTANT: Use only Delco Supreme 11, DOT 3 brake fluid P/N 12377967 (or equivalent) from a clean sealed container.

10. Bleed brakes (Refer to "Brake System Bleeding" in this manual.)

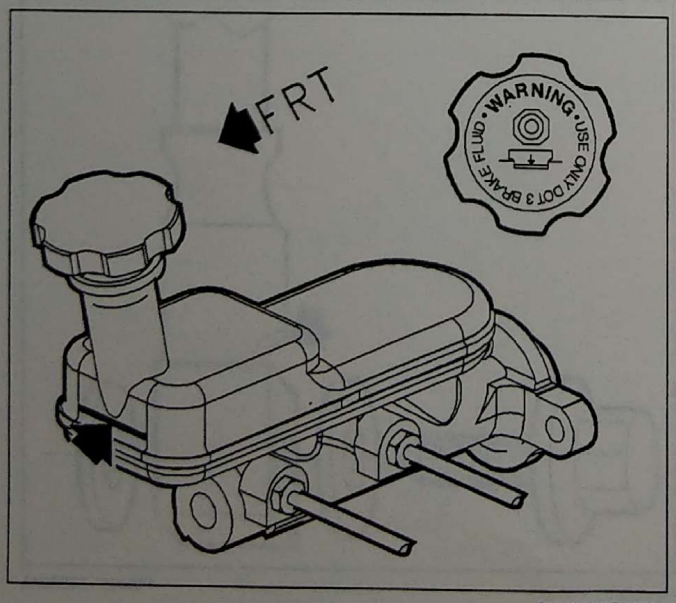
IMPORTANT: Be sure the master cylinder reservoir cap is installed before the brake pedal is depressed. This prevents brake fluid from spraying from the reservoir.

11. Put vehicle in RUN mode.
12. Pump brake pedal firmly and slowly three times to bring shoe and lining assemblies into contact with rotors.

IMPORTANT: Remove foot from brake pedal between applies and wait one second between applications.

IMPORTANT: Check for DTC's. If DTC(s) 51 or 54 are set, clear code(s). Recheck brake system operation.

13. Fill brake fluid reservoir with clean brake fluid up to the proper level.
14. Road test vehicle.



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FRONT WHEEL SPEED SENSOR

REMOVAL

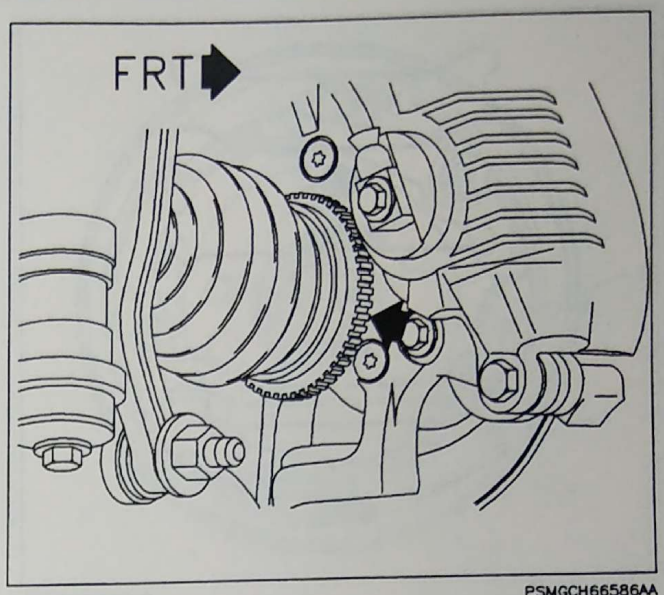
IMPORTANT: Place keypad in LOCK mode.

1. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
2. Disconnect wheel speed sensor electrical connector.

NOTICE: The outer drive axle joint has a speed sensor ring, Be careful not to damage this ring when performing service operations near steering knuckle and drive axle. Never pry against the speed sensor ring. Even minor scratching of the speed sensor ring may result in a loss of ABS operation.

3. Remove wheel speed sensor to steering knuckle bolt.
4. Remove wheel speed sensor.

IMPORTANT: The front wheel speed sensor has a locating pin which may become stuck in the steering knuckle due to corrosion. The pin may separate from the sensor during sensor removal and remain in the steering knuckle. If this happens the pin must be pulled out of the steering knuckle.



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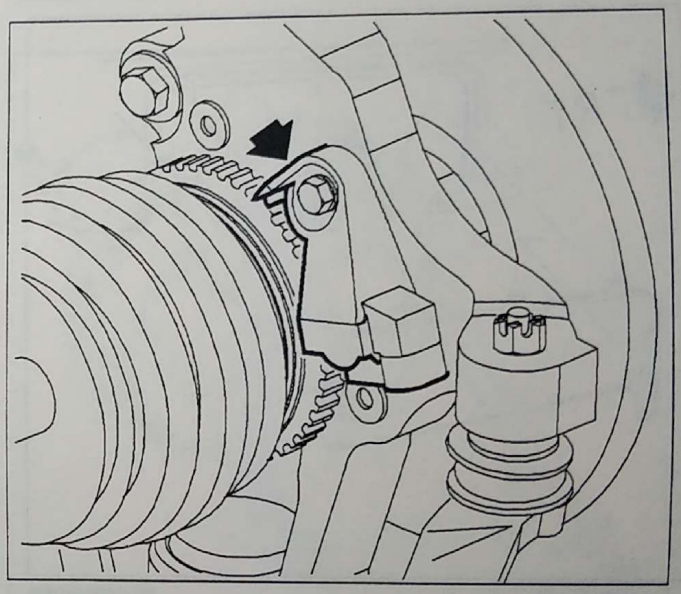
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INSTALLATION

1. Position wheel speed sensor onto steering knuckle.

IMPORTANT: Check to be sure that the sensor is fully seated against the steering knuckle. It may be necessary to clean corrosion or another obstruction from the locating pin hole. Use coarse sand paper wrapped around a dowel to clean locating pin hole in steering knuckle.

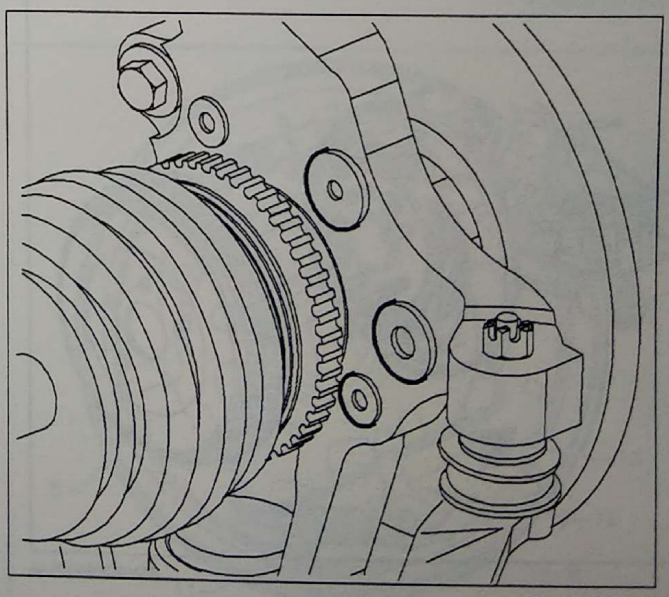
2. Install wheel speed sensor fastener.

Torque: 11 N•m (97 in−lbs)

3. Connect wheel speed sensor electrical connector.

IMPORTANT: Wheel speed sensor requires no adjustment.

4. Lower vehicle from hoist.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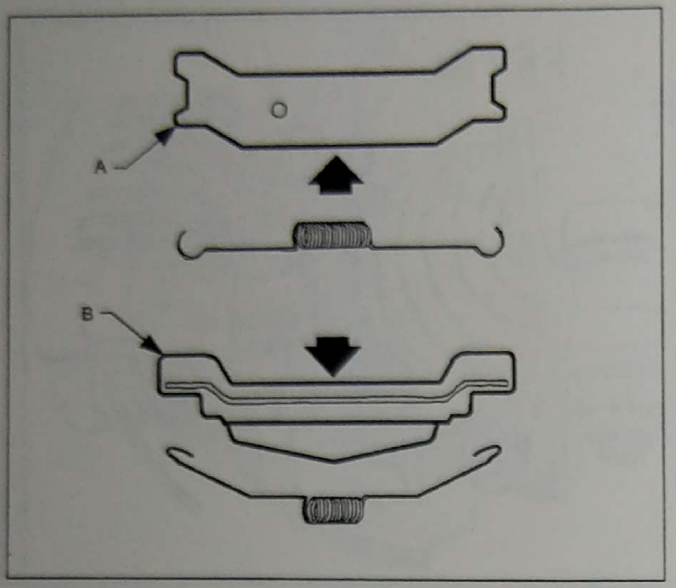

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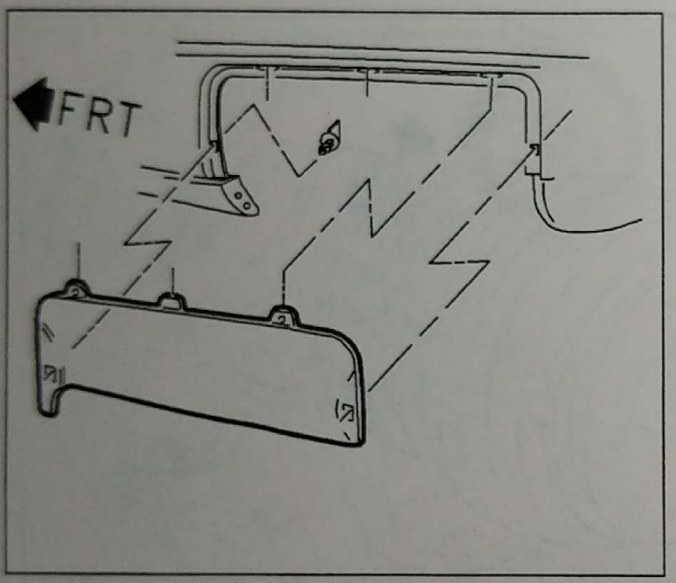

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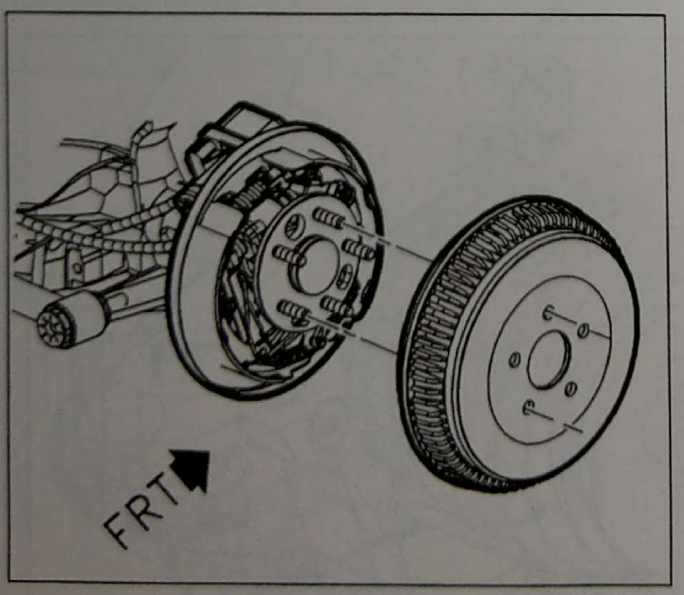

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REAR DRUM BRAKE

Right side brake assembly shown; Left side opposite.

REMOVAL

IMPORTANT: There is a first and second design rear drum brake assembly. The first design uses a straight strut, straight strut spring (A), 20 tooth adjuster screw and non−grooved linings. The second design uses a offset strut, offset strut spring (B), 26 tooth adjuster screw and grooved linings. There are no service parts (other than shoes/linings) available for the first design rear drum brake assembly. If the first design rear drum brake assembly requires service, it must be replaced by a second design rear drum brake assembly. Never replace brake shoes/linings on one side of axle only. Brake shoes/linings must be replaced as axle sets.

1. Release park brake.
   a. Place keypad in LOCK mode.
   b. Depress brake pedal.
   c. While brake pedal is depress, push park brake apply/release button.

NOTICE: Parking brake must be OFF for removal of brake drum(s). Brake drum(s) cannot be removed with the parking brake set.

2. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
3. Remove rear wheel opening cover(s).
4. Remove rear road wheel(s).
5. Remove rear brake drum(s).

NOTICE: Do not pry against brake backing plate. This will bend plate.

NOTICE: Do not apply brake pedal or parking brake with rear drum removed. This may damage brake actuator assembly.

IMPORTANT: If difficulty is encountered removing drum(s);

   a. Make sure park brake is released.
   b. Remove rear brake apply/park latch motor. (Refer to "Rear Brake Apply/Park Latch Motor Installation" in this manual.)
   c. Remove knock out plate from backing plate.
   d. Use drum brake adjusting tool SA9201BR or equivalent to turn star wheel of adjuster assembly to shorten its length and provide sufficient drum-to-shoe clearance for drum removal.

e. Use a rubber mallet to tap gently on outer rim of drum and/or around inner drum diameter by hub flange, while pulling outward on drum assembly. Take care not to deform drum assembly by excessive use of force.

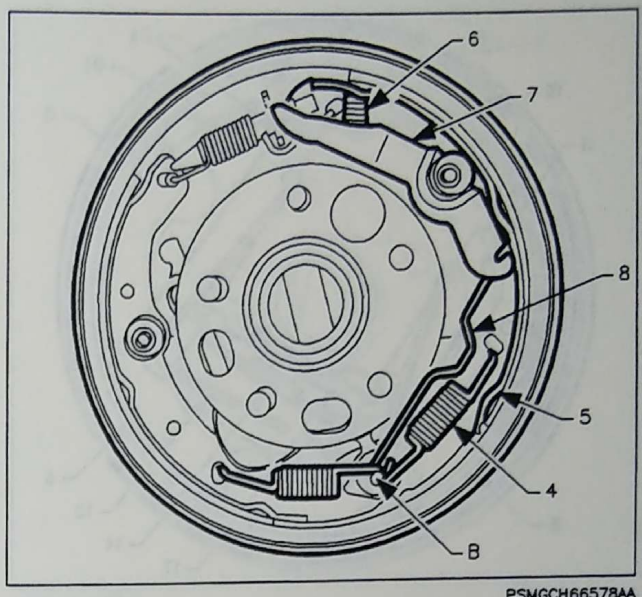
f. If knock out plate was removed, it will be necessary to install a service knock out plug upon reassemble (plug available through service parts).

g. Install rear brake apply/park latch motor. (Refer to "Rear Brake Apply/Park Latch Motor Installation" in this manual.)

6. Remove return spring (4) from post (B) and lining (5).

NOTICE: Do not over extend spring. Over extending spring will weaken it.

7. Remove spring (6) from between adjuster actuator lever (7) and lining (5).
8. Remove link (8) from adjuster actuator lever (7) and post (B).
9. Remove two-shoe-hold-down spring assemblies (9), adjuster actuator lever (7), and bushing (10) from linings (5).
10. Remove return spring (11) from post (B) and lining (5).
11. Remove guide plate (12) from post (B) and anti-rattle spring (13).



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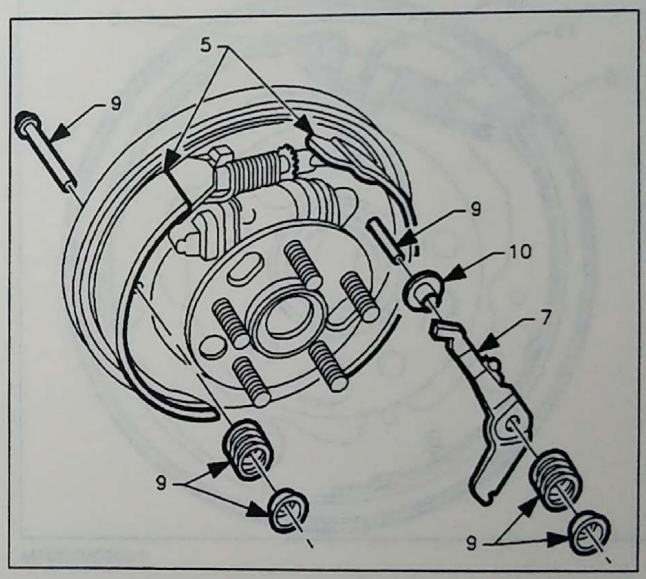

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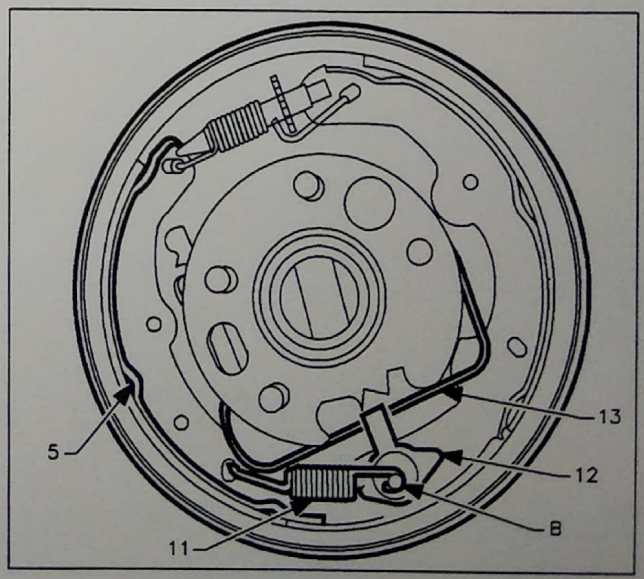

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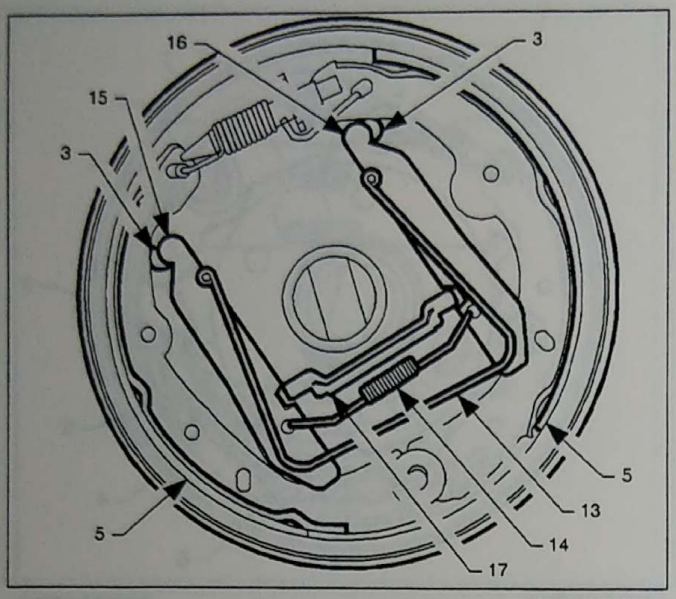

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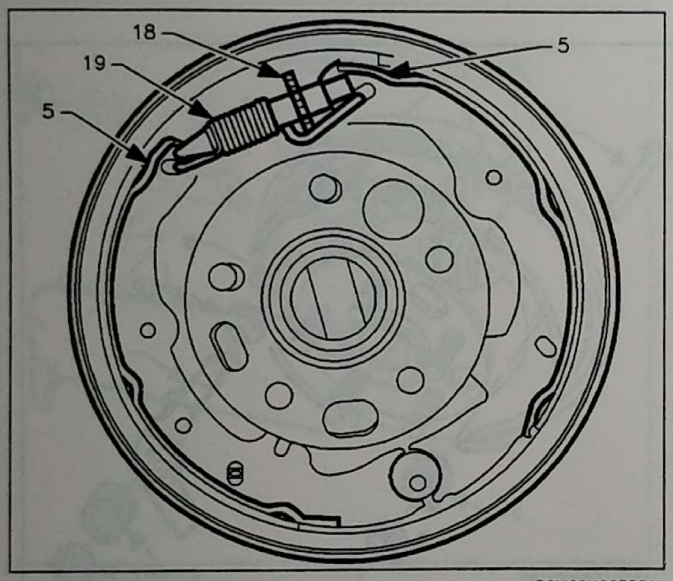

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12. Remove strut spring (14) from levers (15) and (16).
13. Remove strut (17), levers (15) and (16).
14. Remove linings (5) with adjusting screw (18) and adjusting screw spring (19) from linings (5).
15. Remove adjusting screw (18) and adjusting screw spring (19) from linings (5).

IMPORTANT: Replace all parts that appear over-stressed, worn, or discolored from heat.

ASSEMBLY

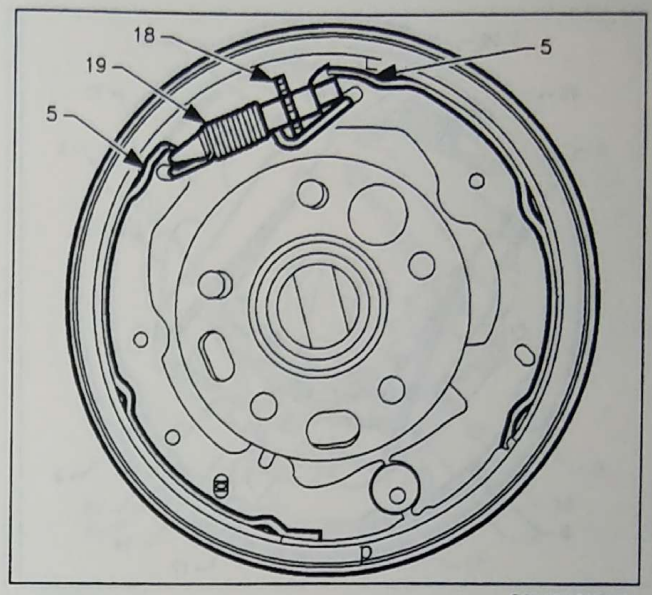
Right side brake assembly shown; left side opposite.

IMPORTANT: Never replace brake shoes/linings on one side of axle only. Brake shoes/linings must be replaced as axle sets.

IMPORTANT: Before reinstalling adjusting screw (18), it must be disassembled, thoroughly cleaned, and lubricated. Clean adjusting screw (18) threads with a wire brush. Wash all components in clean denatured alcohol. Apply brake lubricant GM P/N1052196 (or equivalent) to adjusting screw (18) threads, inside diameter of socket, and socket face. Adjusting screw (18) is properly lubricated when it is assembled and threaded in completely and two small continuous beads of grease are visible. Inspect threads of adjusting screw for smooth operation through its full length of travel.

1. Lubricate shoe pads on each backing plate with GM P/N1052196 (or equivalent).
2. Install adjuster screw (18) with adjuster screw spring (19) on linings (5).
3. Install linings (5) on vehicle with bushing (10), adjuster actuator lever (7), and two-hold-down spring assemblies (9).

IMPORTANT: Electric Vehicle (or equivalent) replacement brake lining material is recommended for this vehicle to maintain the balance between the front and rear brake performance. Electric Vehicle (or equivalent) replacement brake parts have been carefully selected to provide the proper brake balance for the purpose of stopping distance and control over the full range of operating conditions. Installation of rear brake lining material with performance characteristics different from the recommended Electric Vehicle (or equivalent) replacement parts can damage the metal matric composite (MMC) rear brake drum as well as change the intended brake balance for this vehicle.



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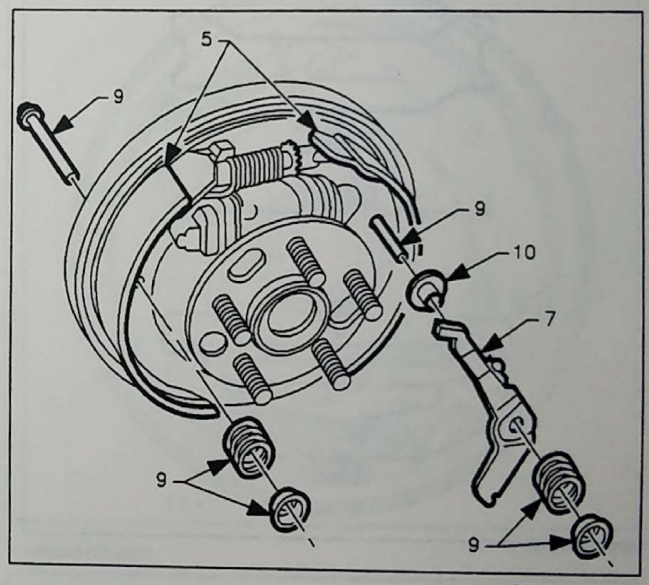

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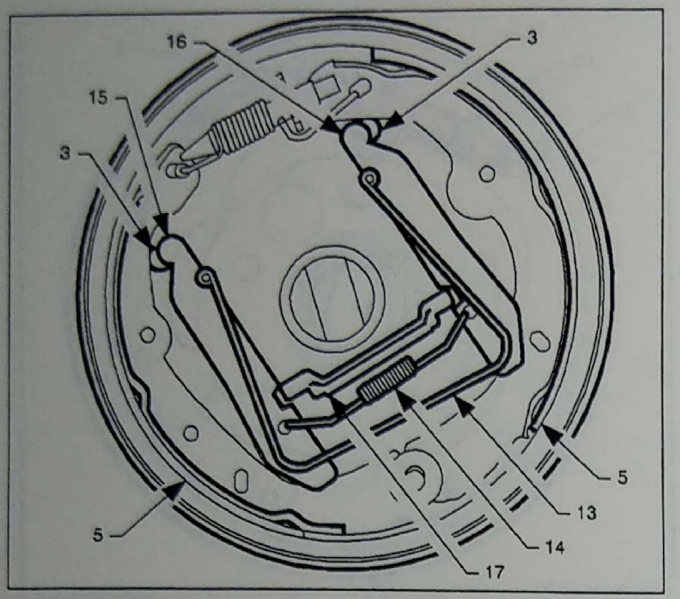

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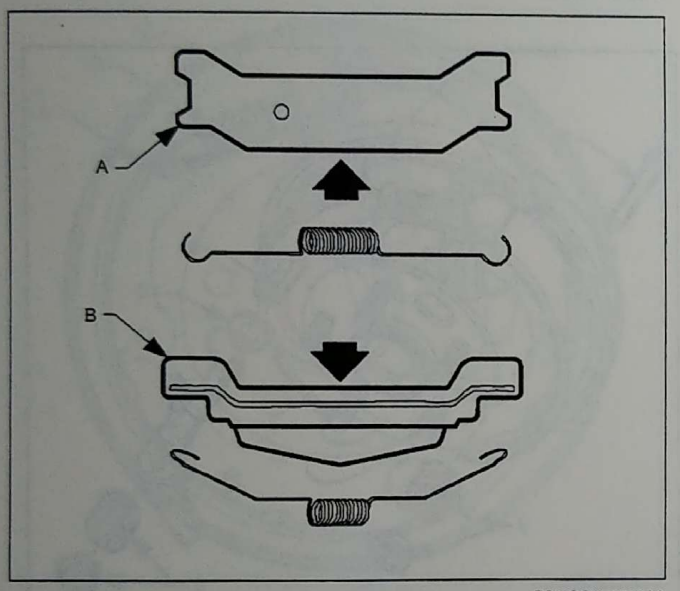
4. Apply a small amount (a visible film must cover all points) of GM 1052196 lubricant to lever ends (15) and (16) and to lever-to-shoe contact points (two places). Install two levers (15) and (16) in slots in linings (5).

IMPORTANT: There is a first and second design rear drum brake assembly. The first design uses a straight strut and strut spring (A). The second design uses a offset strut and strut spring (B).

NOTICE: Do not inter mix first and second design struts and springs, or brake damage may occur.



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5. Connect strut (17) between levers (15) and (16). Arrow in illustration indicates this side out.

6. Connect strut spring (14) between levers (15) and (16).

NOTICE: Do not over extend spring. Over extending spring will weaken it.

7. Connect anti-rattle spring (13) between levers (15) and (16).
8. Install guide plate (12) with hook side facing outwords on post (B) and anti-rattle spring (13).
9. Connect return spring (11) on post (B) and lining (5), opposite the adjuster actuator lever (7), on right side. On left side, return spring (11) is on the same side as adjuster actuator lever (7).
10. Install link (8) on post (B) and adjustor actuator lever (7).
11. Install return spring (4) on post (B) and lining (5).
12. Connect spring (6) between adjuster actuator lever (7) and lining (5).
13. Adjust brakes.
    a. Using a 0−228 mm (0−9 in) caliper, measure the inside diameter of rear brake drum.

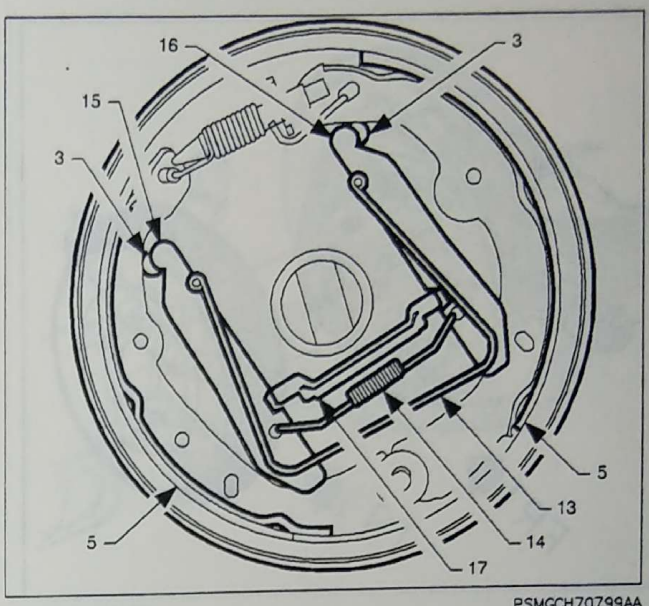
Rear Brake Drum Diameter.

Inside Diameter	**225.0 mm (8.865 in)**
Discard Diameter	**226.3 mm (8.916 in)**

    b. Measure outside diameter of brake shoes and adjust brake adjuster to obtain 0.75 mm (.030 in) less than the reading obtained in step a.

IMPORTANT: Refer to "Inspecting Rear Brake Drums" in the "Diagnosis and Inspection" section in this manual.

IMPORTANT: The EV1 uses a metal matrix composite (MMC) rear brake drum. Scored appearance is typical, do not refinish. The metal matric composite (MMC) rear brake drum is serviced by replacement only.



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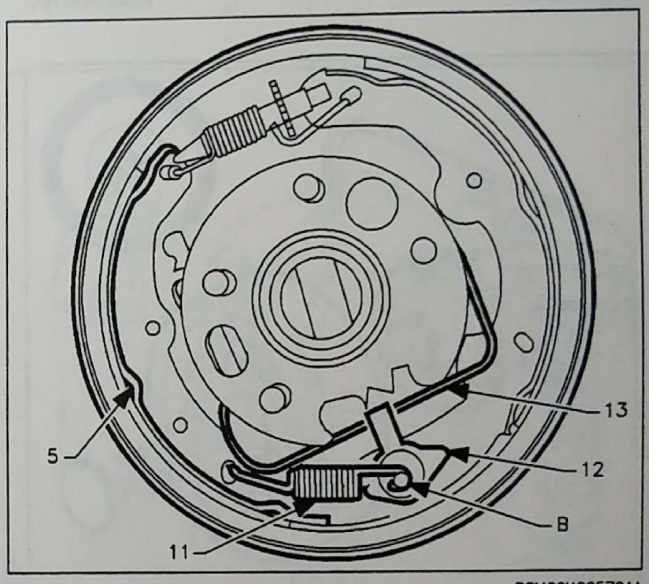

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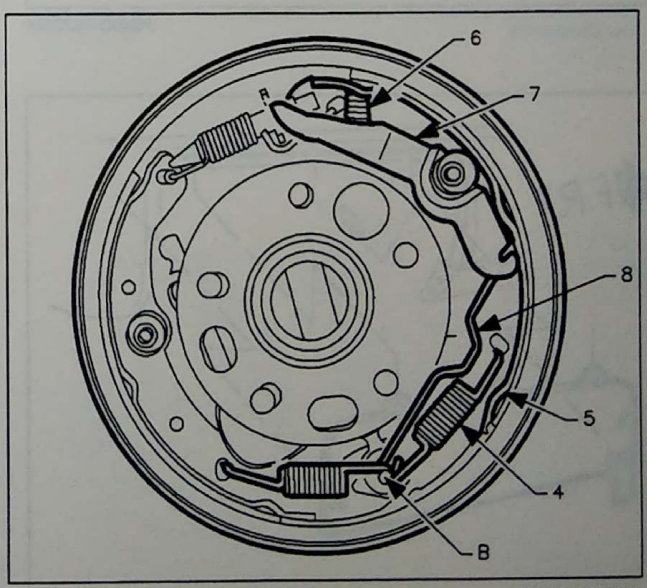

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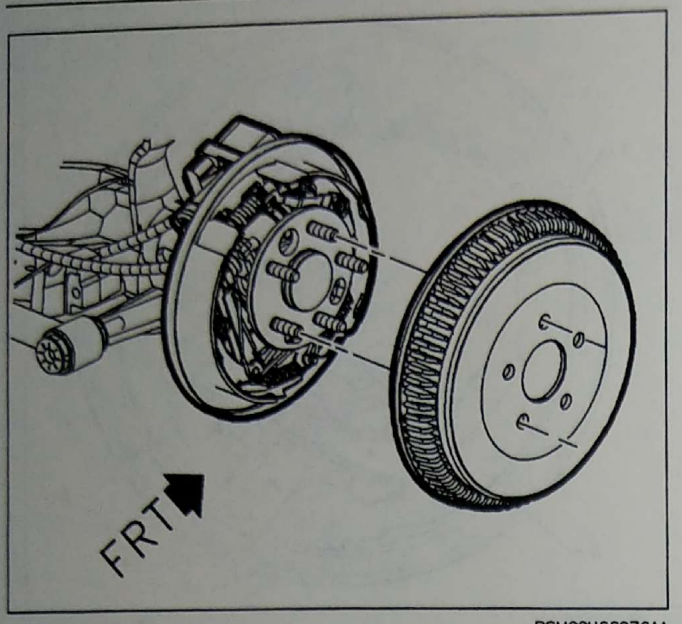

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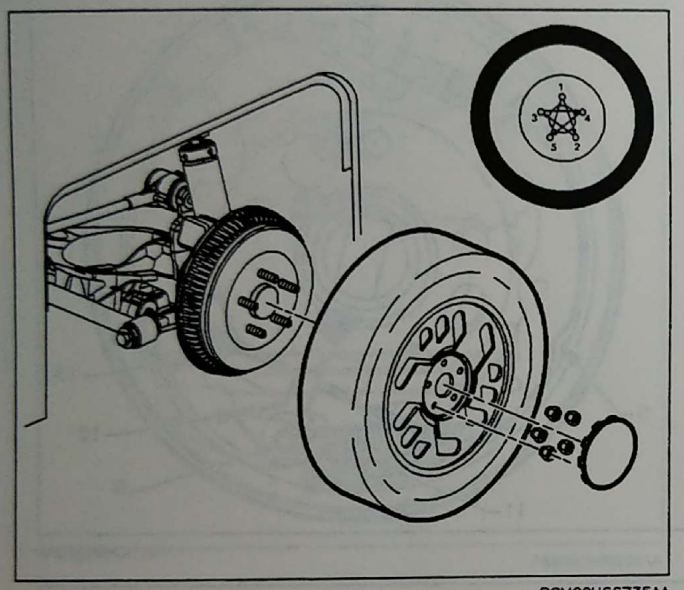

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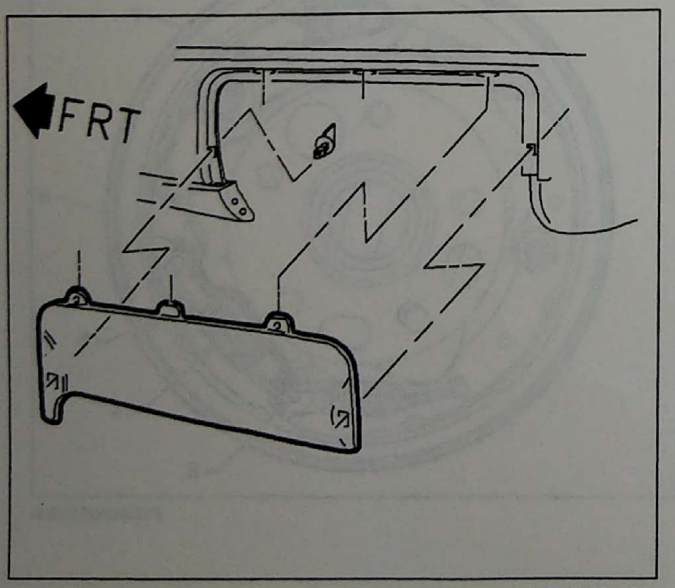

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14. Install rear brake drum.
15. Repeat steps 1 through 14 for opposite side.

NOTICE: Before installing wheels, remove rust or corrosion from wheel mounting surfaces. Failure to do so can cause wheel lug nuts to loosen in service.

16. Position wheel(s) on hub.
17. Install wheel lug nuts and tighten in a star pattern. Repeat tightening pattern to make sure torque is correct.

Torque: 120 N•m (89 ft−lbs)

18. Install rear wheel opening cover(s).
19. Lower vehicle from hoist.
20. Road test vehicle.

CamScanner

REAR BRAKE APPLY/PARK LATCH MOTOR

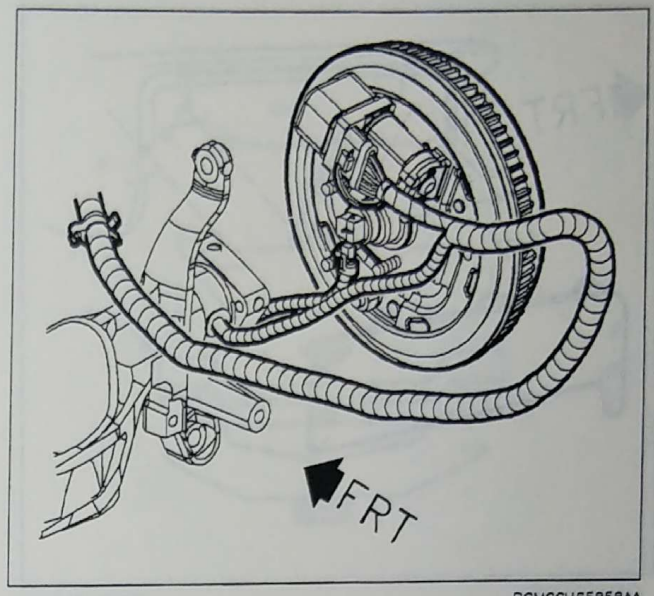
REMOVAL

IMPORTANT: Place keypad in LOCK mode.

1. Raise vehicle on hoist. (Refer to "Lifiting, Jacking, and Support Points" in this manual.)
2. Disconnect electrical connector from rear brake apply/park latch motor (1).

NOTICE: Rubber gasket (A) should be removed with motor. If gasket (A) is left on actuator gear, new motor will not mesh correctly with actuator.

3. Remove nuts (2) securing (1) rear brake apply/park latch motor.
4. Remove (1) rear brake apply/park latch motor from (3) actuator.



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INSTALLATION

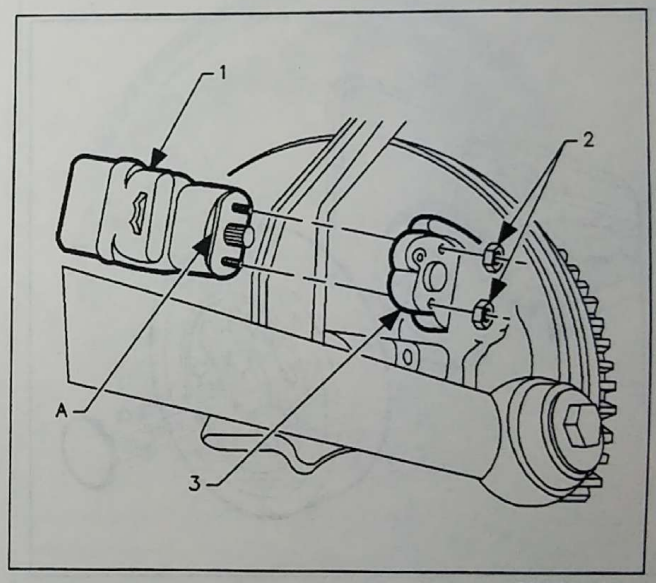
1. Install (1) rear brake apply/park latch motor on (3) actuator.

IMPORTANT: Rubber gasket (A) should be installed on motor prior to installation. If difficulty is encouted engaging motor drive pinion with actuator gear, rotate motor drive pinion. If drive pinion will not rotate, connect electrical connector to rear brake motor and cycle, park brake switch, ON−OFF. Pinion will not rotate if latched.

2. Secure (1) rear brake apply/park latch motor to (3) actuator with (2) nuts.

Torque: 2.7 N•m (24 in−lbs)

3. Connect electrical connector to rear brake apply/park latch motor.
4. Lower vehicle from hoist.



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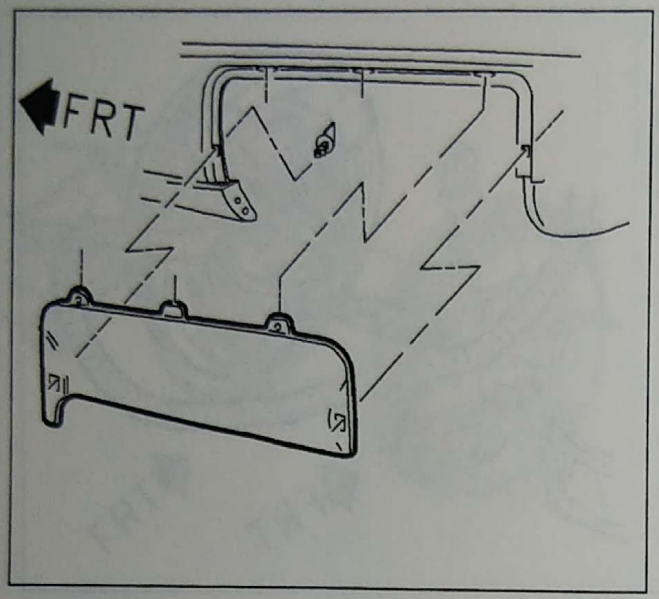

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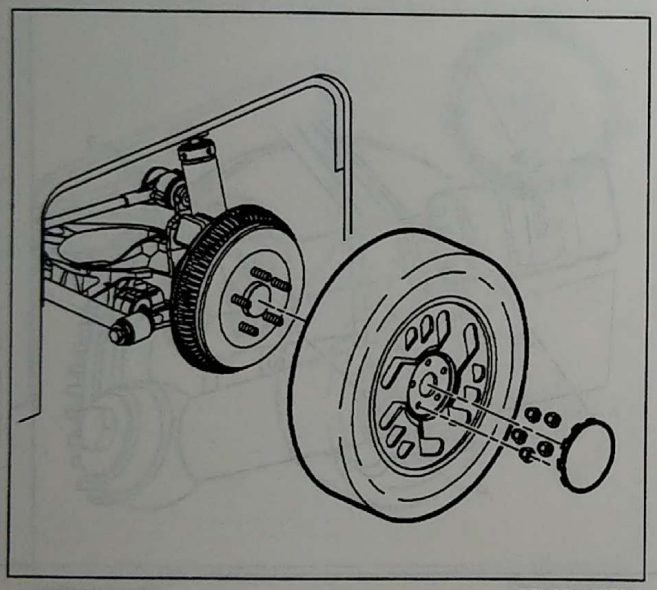

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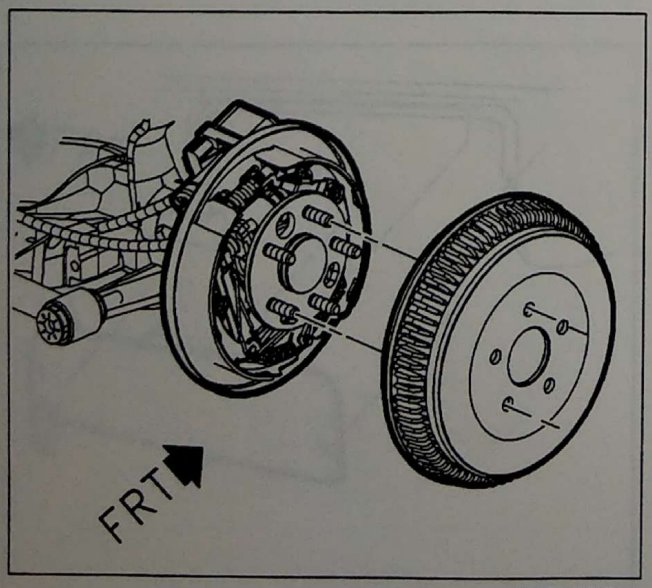

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REAR BRAKE BACKING PLATE/GEAR HOUSING ASSEMBLY

REMOVAL

Right side rear drum brake assembly shown; Left side opposite.

1. Release park brake.
   a. Place keypad in LOCK mode.
   b. Depress brake pedal.
   c. While brake pedal is depress, push park brake apply/release button.

NOTICE: Parking brake must be OFF for removal of brake drum(s). Brake drum(s) cannot be removed with the parking brake set.

2. Raise vehicle on hoist. (Refer to "Lifting, Jacking and Support Points" in this manual.)
3. Remove rear wheel opening cover(s).
4. Remove rear road wheel(s).
5. Remove rear brake drum(s).

NOTICE: Do not pry against brake backing plate. This will bend plate.

IMPORTANT: If difficulty is encountered removing drum(s);

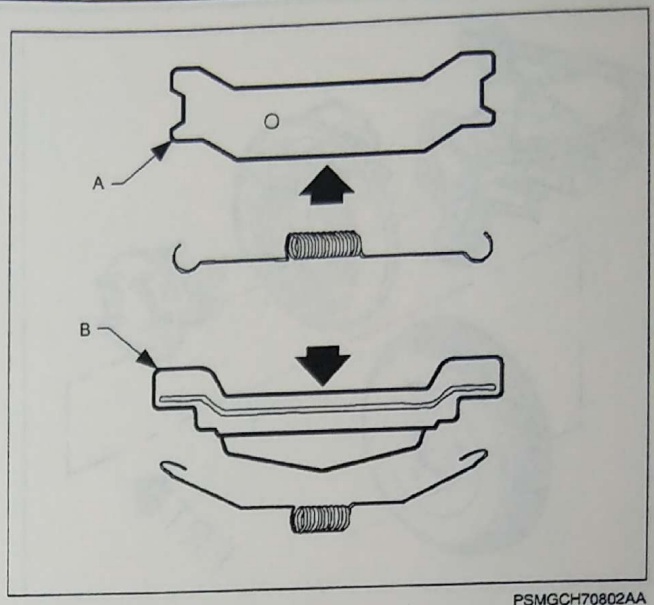
   a. Make sure park brake is released.
   b. Remove rear brake apply/park latch motor. (Refer to "Rear Brake Apply/Park Latch Motor Removal" in this service manual.)
   c. Remove knock out plate from backing plate.
   d. Use drum brake adjusting tool SA9201BR or equivalent to turn star wheel of adjuster assembly to shorten its length and provide sufficient drum-to-shoe clearance for drum removal.
   e. Use a rubber mallet to tap gently on outer rim of drum and/or around inner drum diameter by hub flange, while pulling outward on drum assembly. Take care not to deform drum assembly by excessive use of force.

f. If knock out plate was removed, it will be necessary to install a service knock plug upon reassemble (plug available through service parts).

g. Install rear brake apply/park latch motor. (Refer to "Rear Brake Apply/Park Latch Motor Installation" in this service manual.)

IMPORTANT: If vehicle is equipped with a first design rear drum brake assembly with a straight strut and straight spring (A), go to step 6. If equipped with a second design rear drum brake assembly with a offset strut and offset spring (B), go to step 7. Arrow in illustration indicates this side out.

6. Remove return spring (4) from post (B) and remove strut spring (14) and strut (17).



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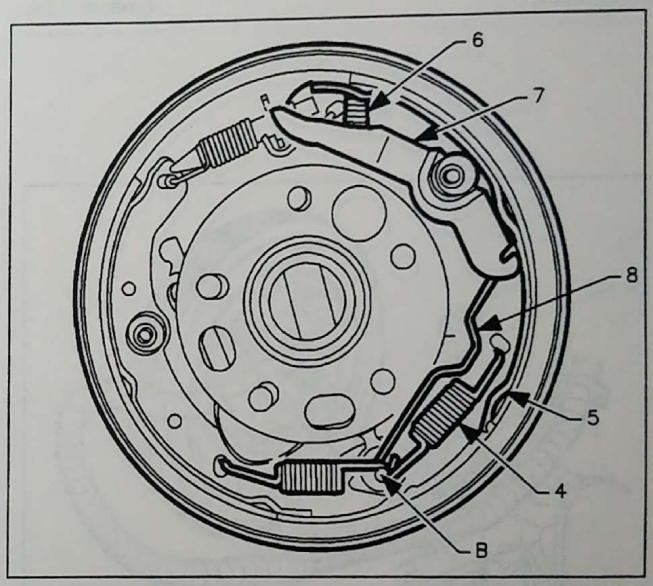

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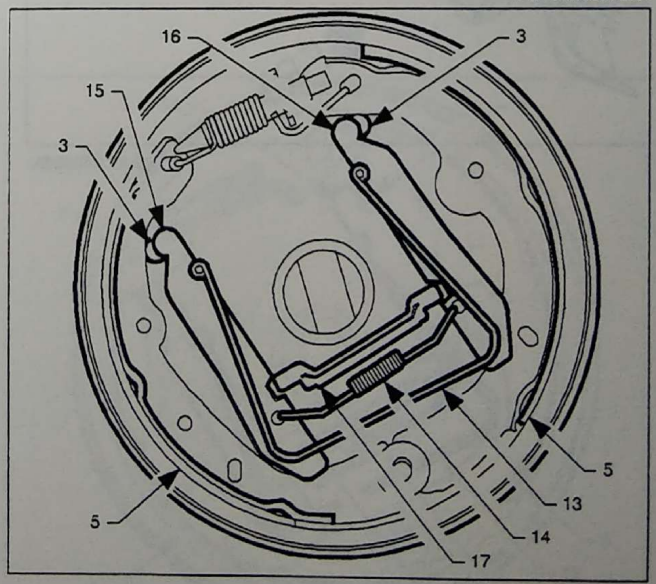

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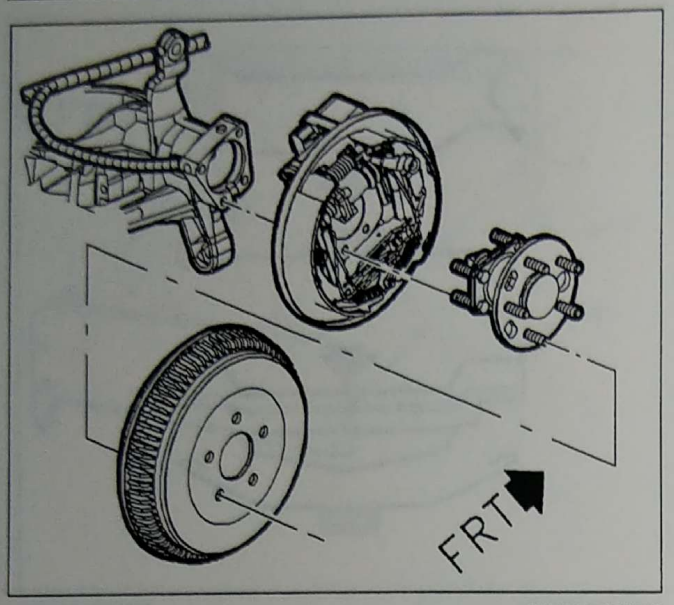

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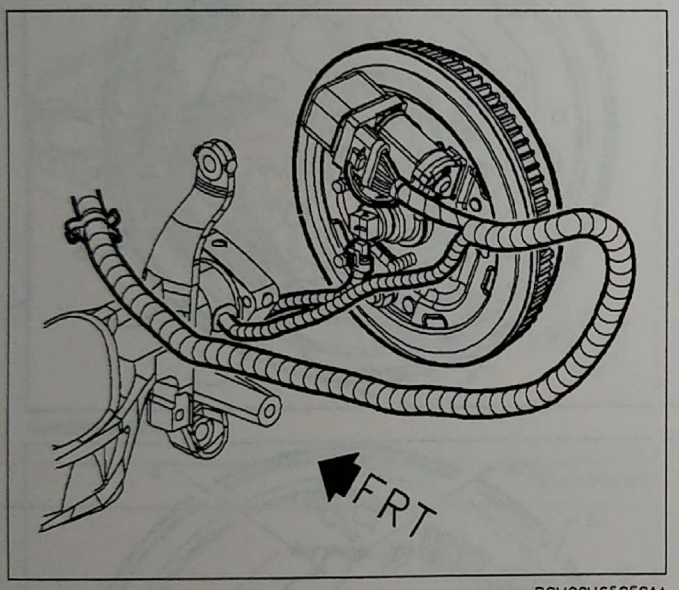

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7. Remove four fasteners securing rear hub assembly to rear axle.
8. Separate hub assembly from rear brake backing plate.
9. Disconnect electrical connector from rear brake apply/park latch motor.
10. Carefully pull complete assembly away from axle and disconnect electrical connector for the wheel speed sensor.
11. Remove rear brake backing plate from vehicle.

INSTALLATION

Right side rear drum brake assembly shown; left side opposite.

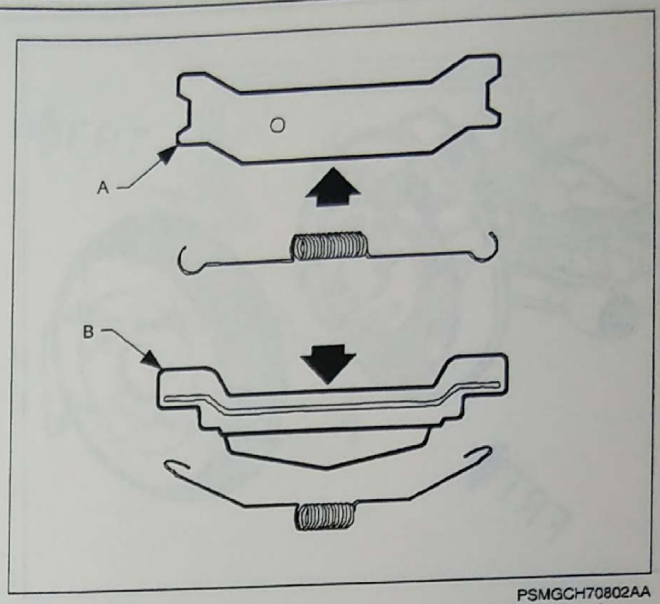
1. Connect electrical connector to rear wheel speed sensor.
2. Position rear hub assembly and backing plate to rear axle and install four fasteners using a flank drive socket.

Torque: 70 N•m (52 ft−lbs)

3. Connect electrical connector to rear brake apply/park latch motor.

IMPORTANT: If vehicle is equipped with a first design rear drum brake assembly with a straight strut and straight spring (A), go to step 4. If equipped with a second design rear drum brake assembly with a offset strut and offset spring (B), go to step 5. Arrow in illustration indicates this side out.

NOTICE: Do not inter mix first and second design struts and springs, or brake damage may occur.



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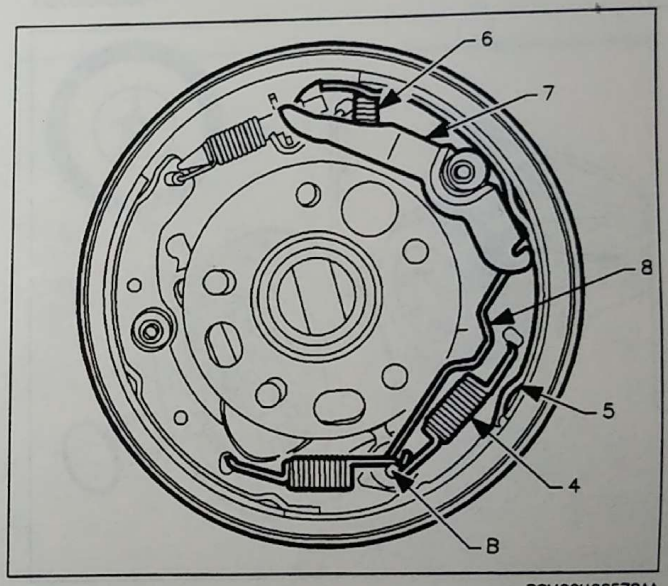
4. Install strut (17) and strut spring (14) and install return spring (4) between lining and post (B).



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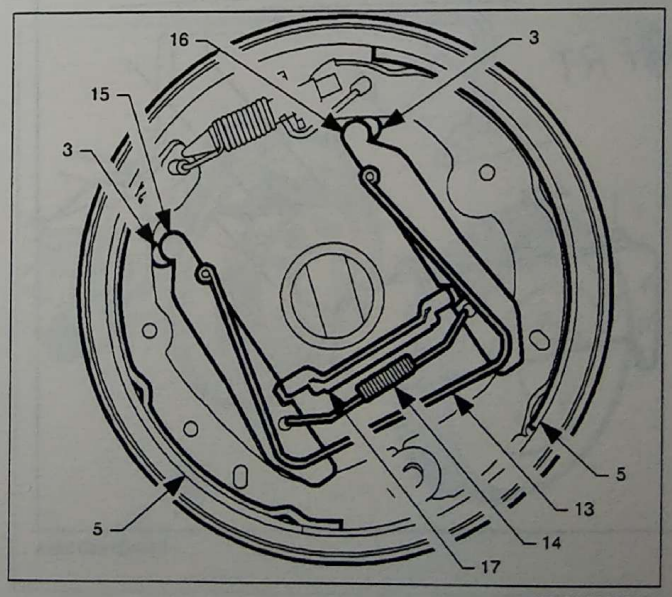

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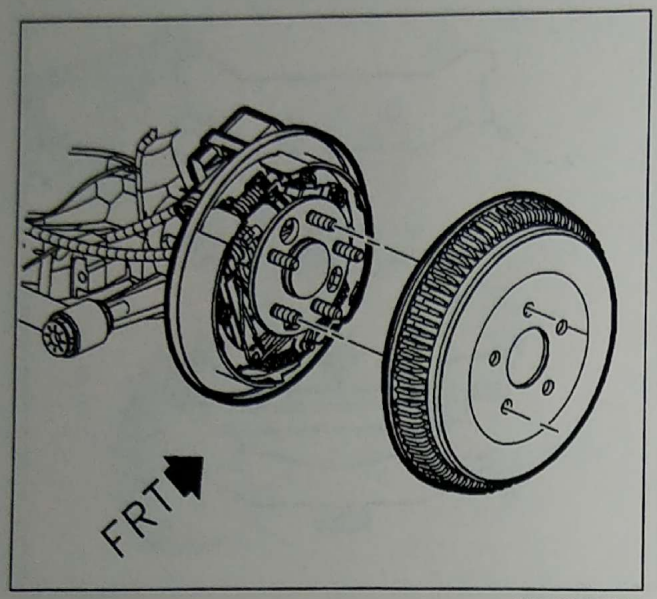

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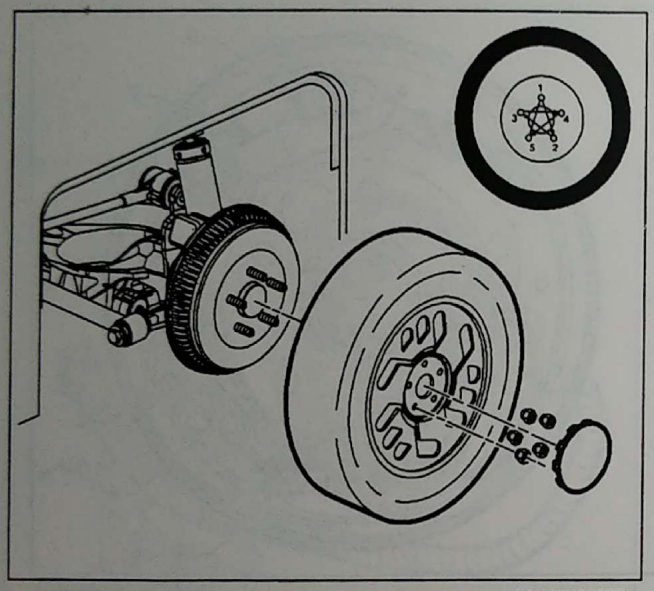

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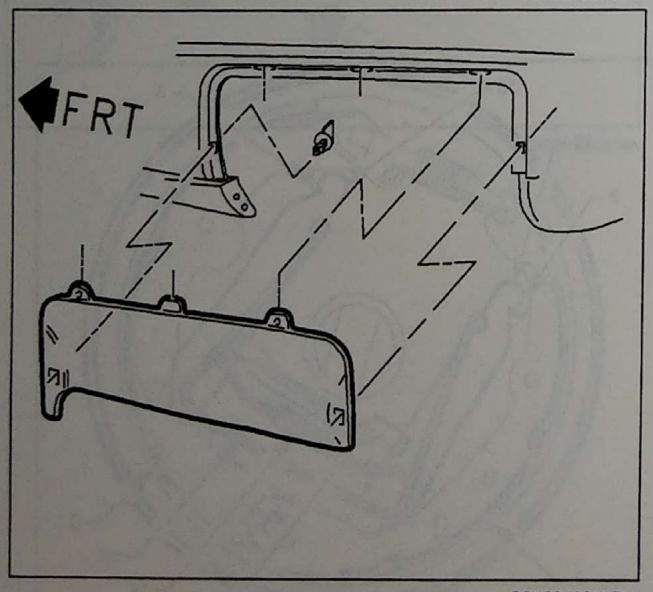

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5. Install rear brake drum.

NOTICE: Before installing wheels, remove rust or corrosion from wheel mounting surfaces and brake drums. Failure to do so can cause wheel lug nuts to loosen in service.

6. Position wheel on hub.
7. Install wheel lug nuts and tighten in a star pattern. Repeat tightening pattern to make sure torque is correct.

Torque: 120 N•m (89 ft−lbs)

8. Install rear wheel opening cover and lower vehicle from hoist.

REAR WHEEL SPEED SENSOR

REMOVAL

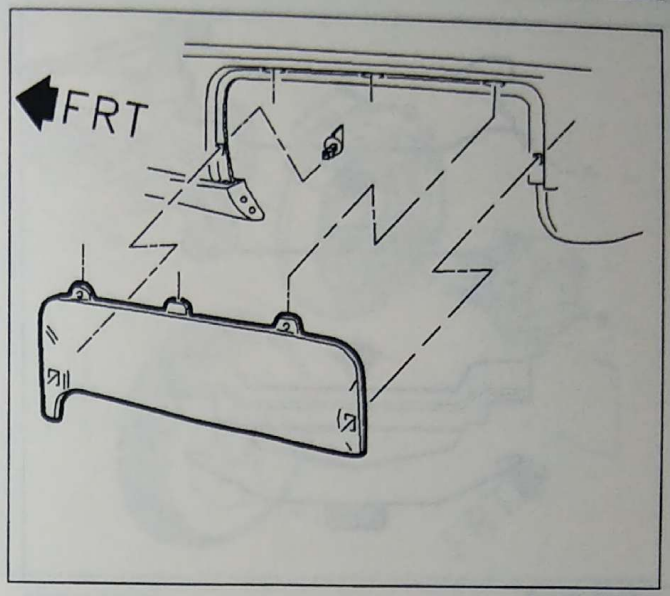
NOTICE: The rear wheel speed sensor is contained within the rear hub/bearing assembly. The sensor is not serviceable. To replace a damaged rear wheel speed sensor, the entire rear hub/bearing assembly must be replaced.

1. Release park brake.
   a. Place keypad in LOCK mode.
   b. Depress brake pedal.
   c. While brake pedal is depress, push park brake apply/release button.
2. Raise vehicle on hoist. (Refer to "Lifting, Jacking, and Support Points" in this manual.)
3. Remove rear wheel opening cover.
4. Remove road wheel(s) from hub being serviced.
5. Remove rear brake drum(s).

NOTICE: Do not apply brake pedal or parking brake with rear drum removed. This may damage brake actuator assembly.

IMPORTANT: If difficulty is encountered removing drum(s);

   a. Make sure park brake is released.
   b. Remove rear brake apply/park latch motor. (Refer to "Rear Brake Apply/Park Latch Motor Removal" in this service manual.)
   c. Remove knock out plate from backing plate.
   d. Use drum brake adjusting tool SA9201BR or equivalent to turn star wheel of adjuster assembly to shorten its length and provide sufficient drum-to-shoe clearance for drum removal.
   e. Use a rubber mallet to tap gently on outer rim of drum and/or around inner drum diameter by hub flange, while pulling outward on drum assembly. Take care not to deform drum assembly by excessive use of force.
   f. If knock out plate was removed, it will be necessary to install a service knock plug upon reassemble (plug available through service parts).
   g. Install rear brake apply/park latch motor. (Refer to "Rear Brake Apply/Park Latch Motor Installation" in this manual.)



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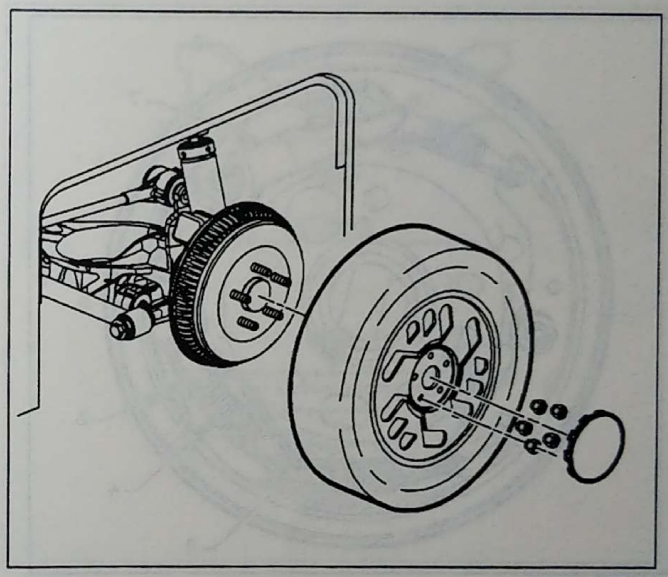
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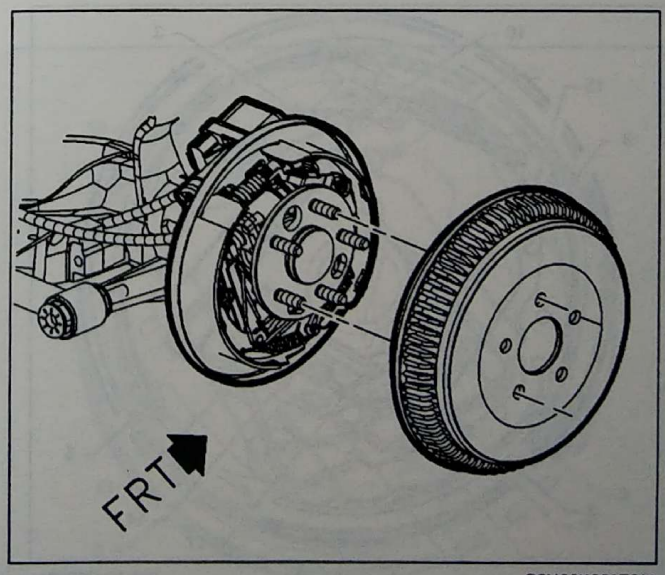

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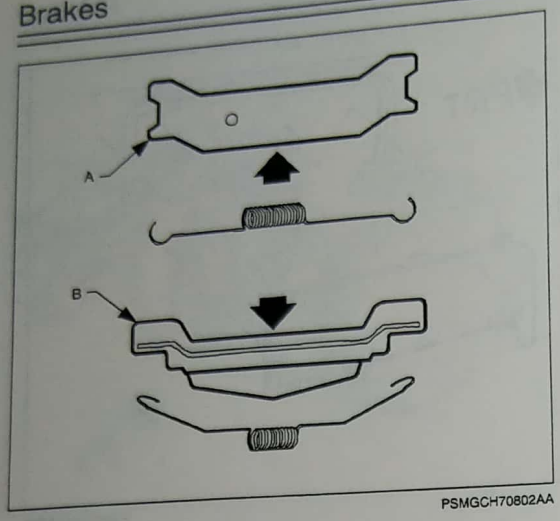

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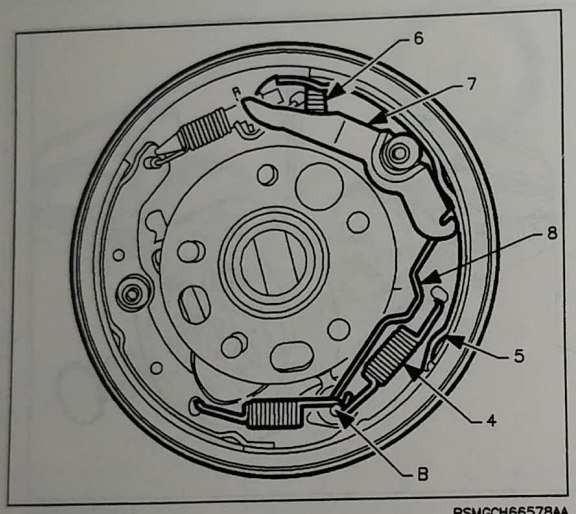
Right side brake assembly shown; left side opposite.

IMPORTANT: If vehicle is equipped with a first design rear drum brake assembly with a straight strut and straight spring (A), go to step 6. If equipped with a second design rear drum brake assembly with a offset strut and offset spring (B), go to step 8. Arrow in illustration indicates this side out.

6. Remove return spring (4) from post (B).
7. Remove strut spring (14) and strut (17).
8. Remove four fasteners securing rear hub assembly to rear axle.
9. Separate hub assembly from rear brake backing plate.
10. Carefully pull complete assembly away from axle and disconnect electrical connector for the wheel speed sensor.



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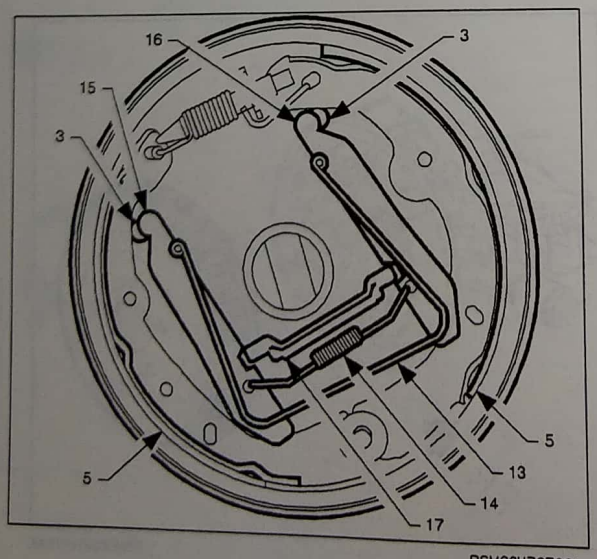

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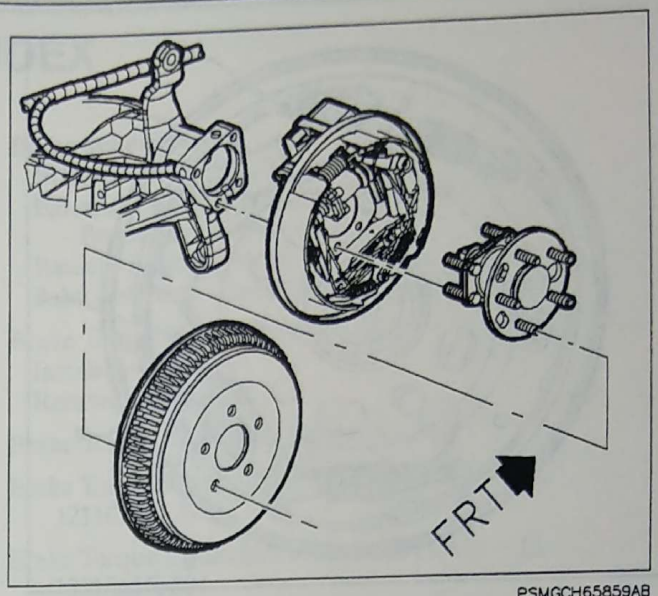
11. Remove hub assembly from vehicle.



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INSTALLATION

Right side brake assembly shown; left side opposite.

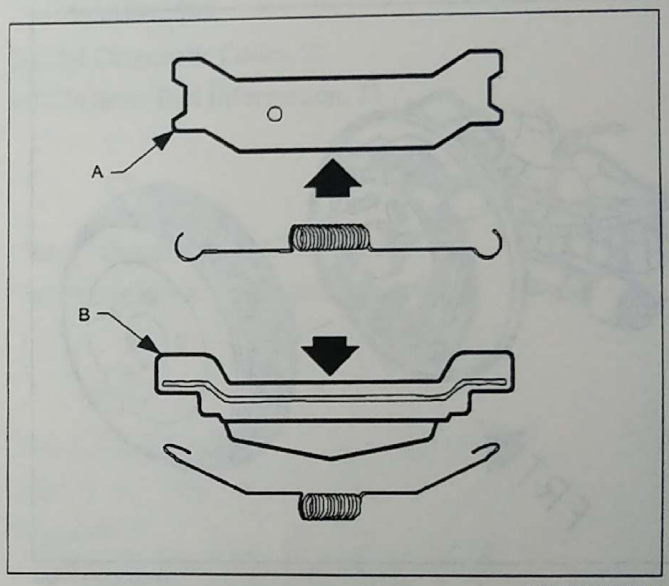
1. Connect rear wheel speed sensor connector to harness.
2. Install rear wheel hub assemble through rear brake assembly and backing plate.
3. Secure rear hub assembly to rear axle with four fasteners and tighten bolts using a flank drive socket.

Torque: 70 N•m (52 ft−lbs)

IMPORTANT: If vehicle is equipped with a first design rear drum brake assembly with a straight strut and straight spring (A), go to step 4. If equipped with a second design rear drum brake assembly with a offset strut and offset spring (B), go to step 6. Arrow in illustration indicates this side out.

NOTICE: Do not inter mix first and second design struts and springs, or brake damage may occur.

4. Install rear brake assembly strut (17) and strut spring (14) between levers (15 and 16).



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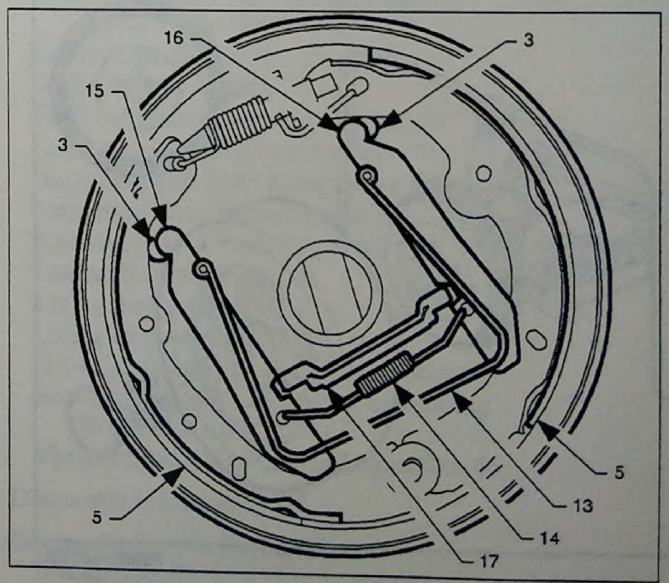

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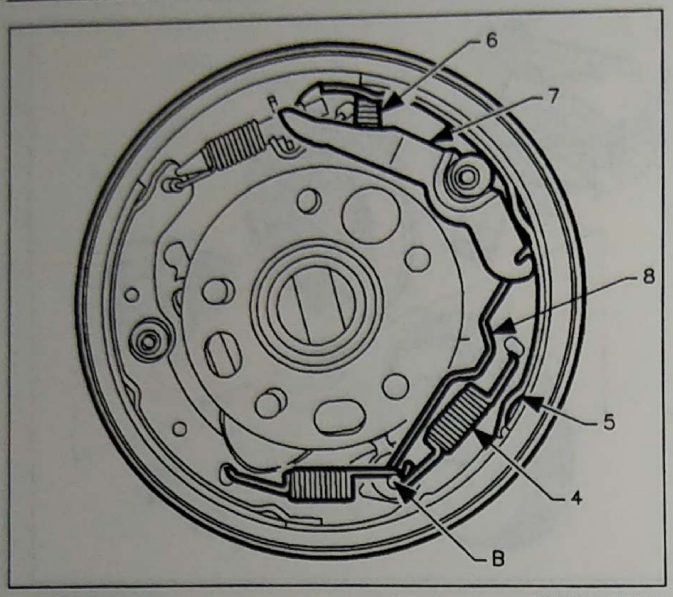

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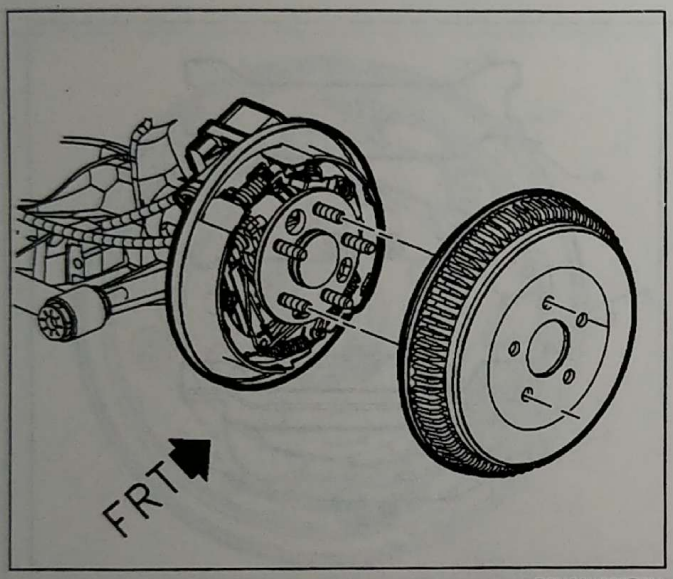
5. Install return spring (4) between lining and post (B).
6. Install rear brake drum.

NOTICE: Before installing wheels, remove rust or corrosion from wheel mounting surfaces and brake drums. Failure to do so can cause wheel lug nuts to loosen in service.

7. Position wheel on hub.



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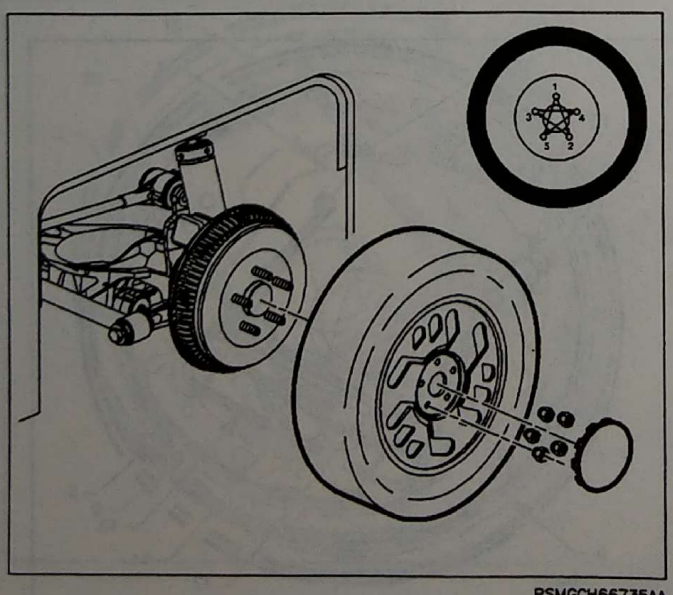
8. Install wheel lug nuts and tighten in a star pattern. Repeat tightening pattern to make sure torque is correct.

Torque: 120 N•m (89 ft−lbs)

9. Install rear wheel opening cover and lower vehicle from hoist.



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EV1 SERVICE MANUAL COMMENT FORM

Use this form if you have any suggestions or see any areas of opportunity for Electric Vehicle Service Manuals.

Service Manual(s) that apply _____

Page number(s) that apply _____

VIN (if applicable) or model and applicable options _____

_____

Describe in detail, the error found or the suggestion(s). Attach additional pages if necessary.

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Mail To: Saturn Corporation
1420 Stephenson Hwy.
P.O. Box 7025
MD 10 Tech. Pubs.
Troy, MI 48007–7025

CamScanner

Service Manual Contents

Diagnostic Trouble Codes (DTCs) and Service Procedures for:

- Brake Torque Control Module
- Diagnostic Charts
- General Information
- Mechanical Brake System
- Electrohydraulic Brake System

NOTE: Refer to the Index in the back of this manual or the Table of Contents in the front of this manual for location of specific component.

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CamScanner